Title: [redacted]RPOLARIZABLE ORGANIC CHROMOPH[redacted]S
Invento[redacted] L.R. Dalton et al.
Docket No.: UOFW117403

DONORS

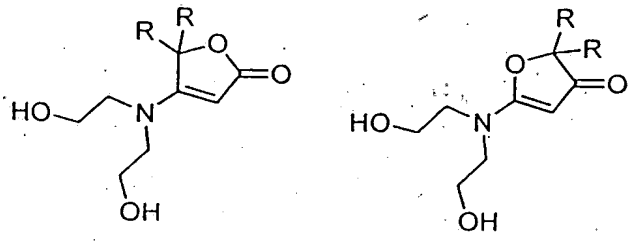
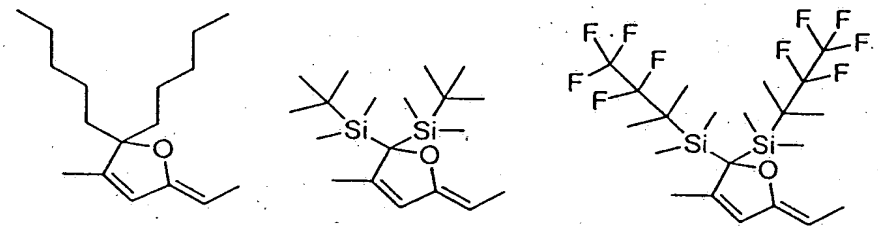


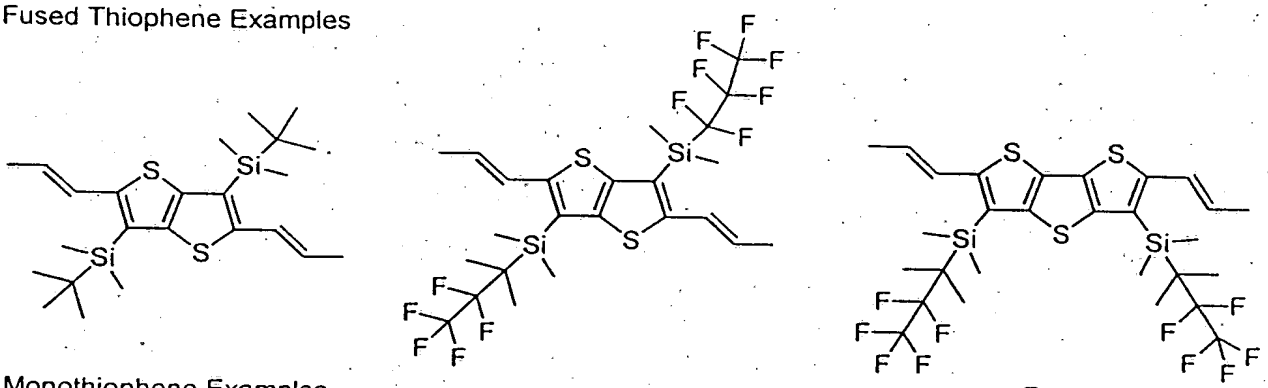
FIGURE 1

BRIDGES

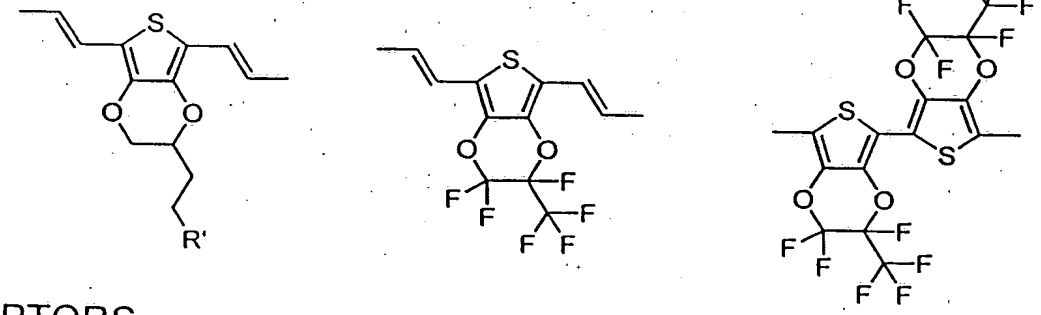
1. Polyene Examples



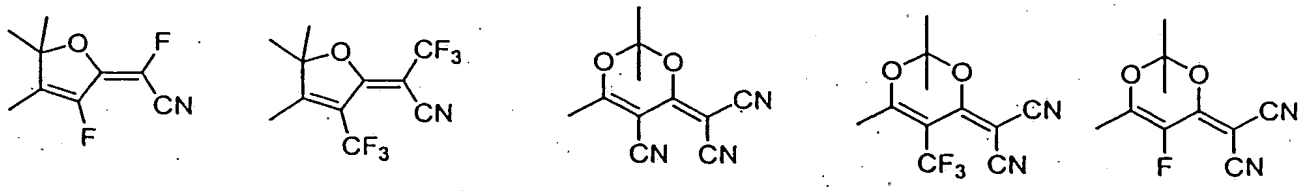
2. Fused Thiophene Examples



3. Monothiophene Examples

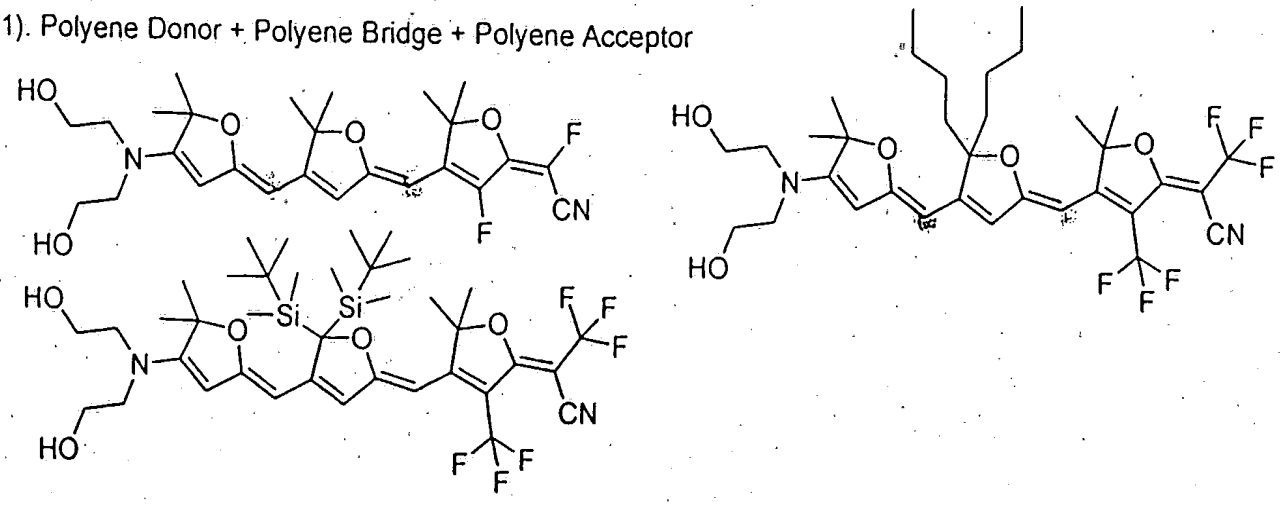


ACCEPTORS

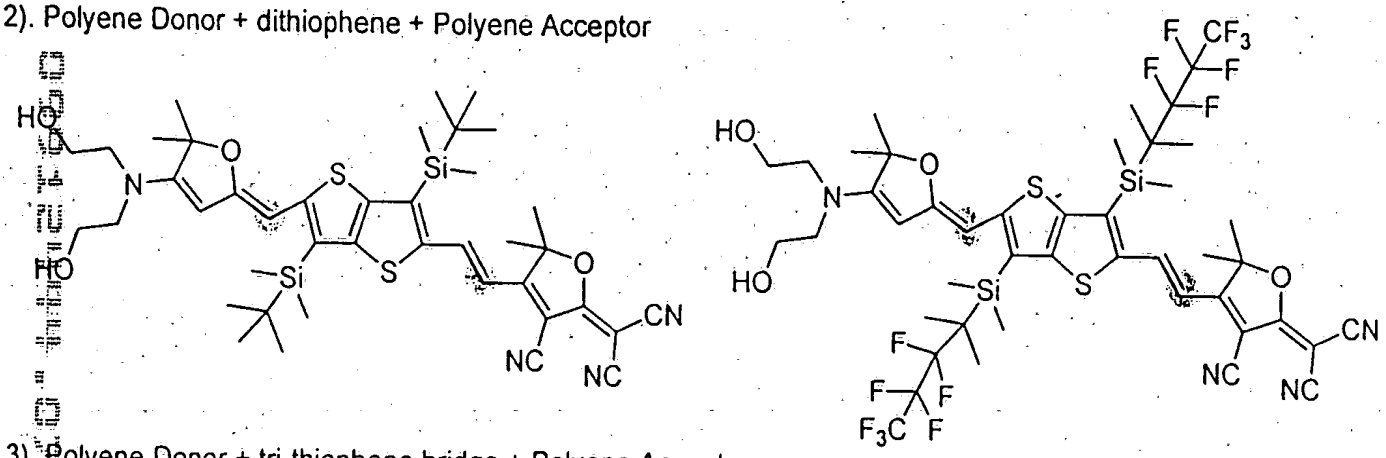


T[redacted]HYPERPOLARIZABLE ORGANIC CHRO[redacted]IORES
In[redacted]tors: L.R. Dalton et al.
Docket No.: UOFW117403

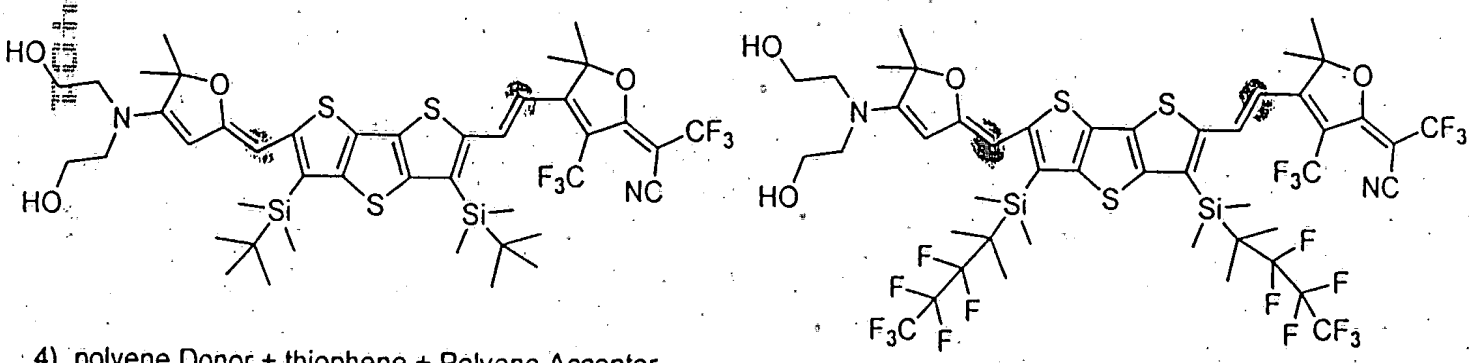
1). Polyene Donor + Polyene Bridge + Polyene Acceptor



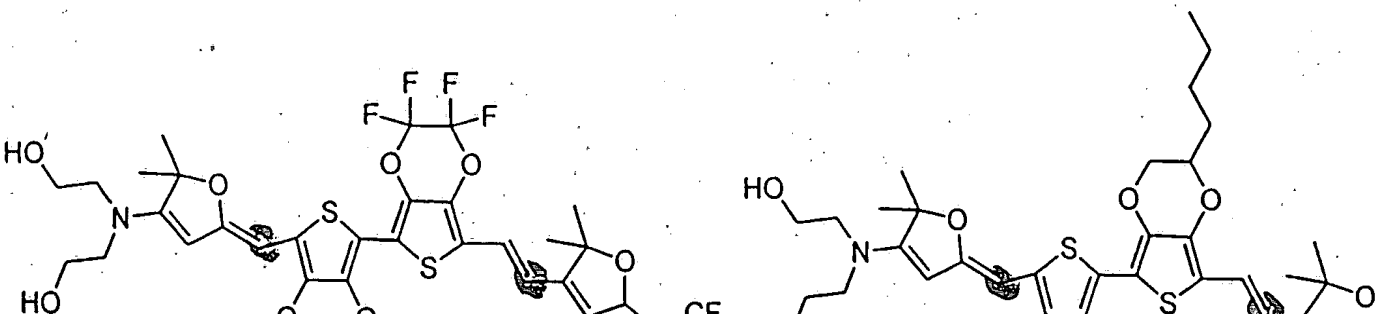
2). Polyene Donor + dithiophene + Polyene Acceptor

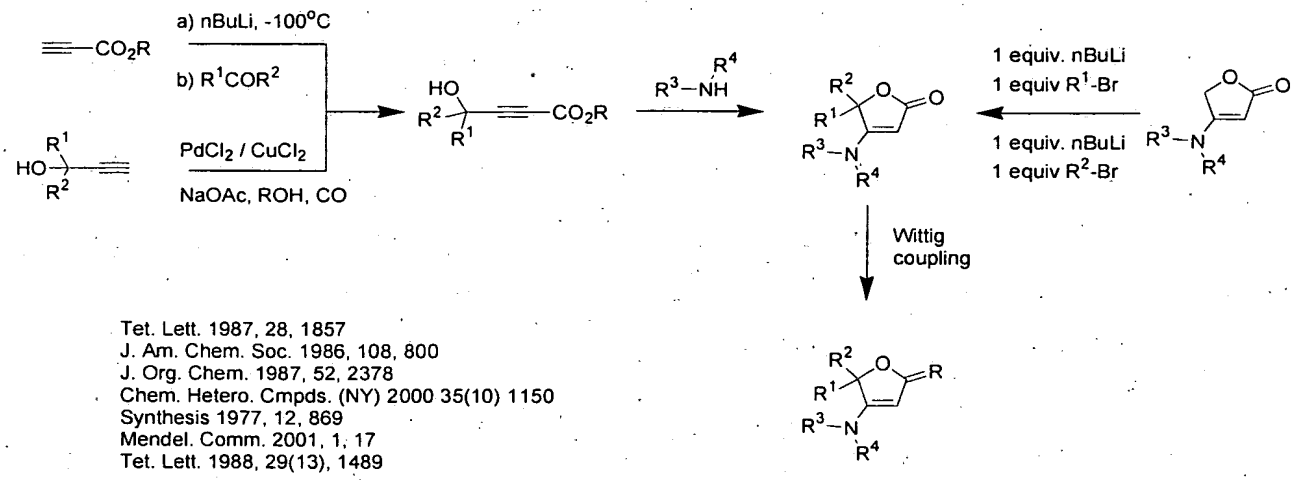


3). Polyene Donor + tri-thiophene bridge + Polyene Acceptor



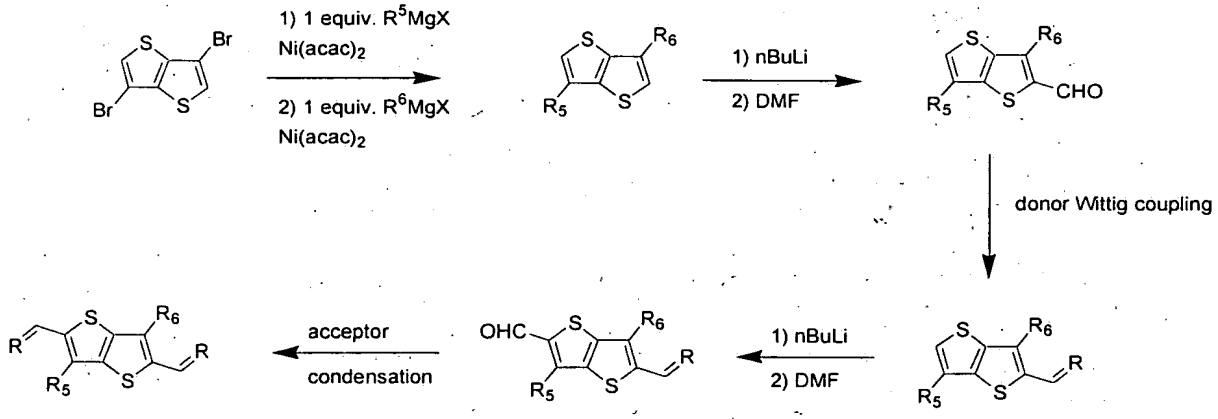
4). polyene Donor + thiophene + Polyene Acceptor





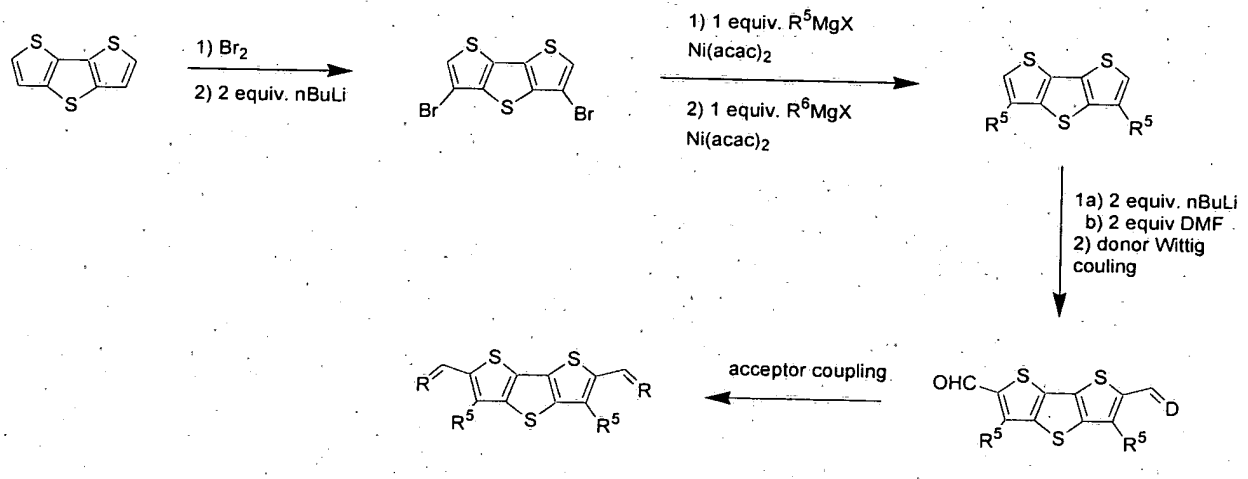
Tet. Lett. 1987, 28, 1857
J. Am. Chem. Soc. 1986, 108, 800
J. Org. Chem. 1987, 52, 2378
Chem. Hetero. Cmpds. (NY) 2000 35(10) 1150
Synthesis 1977, 12, 869
Mendel. Comm. 2001, 1, 17
Tet. Lett. 1988, 29(13), 1489

FIGURE 3



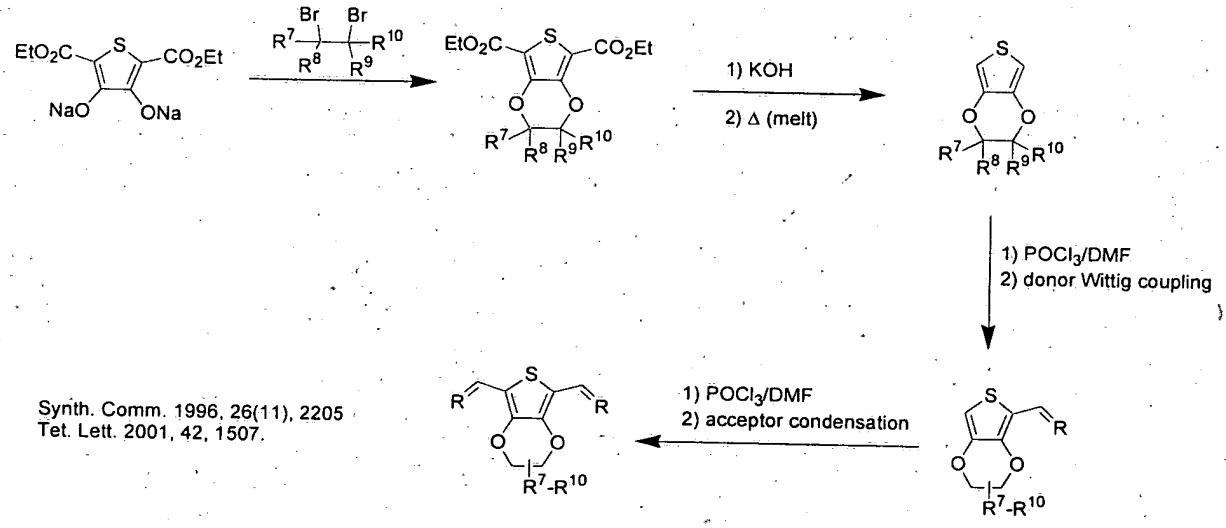
J. Chem. Soc. Perk. Trans. 1 1997, 22, 3465
Heterocycles 1994, 38(1), 143
J. Organomet. Chem. 1973, 50, C12
Pure Appl. Chem. 1980, 52, 669
Tet. Lett. 1981, 22, 4449

FIGURE 4



J. Org. Chem. 1971, 36(12), 1645
J. Chem. Soc. Perk. Trans. 2 1992, 5, 765
J. Mater. Chem. 1999, 9(9), 2227

FIGURE 5



Synth. Comm. 1996, 26(11), 2205
Tet. Lett. 2001, 42, 1507.

FIGURE 6

T[redacted] HYPERPOLARIZABLE ORGANIC CHROMOPHORES
I[redacted]ors: L.R. Dalton et al.
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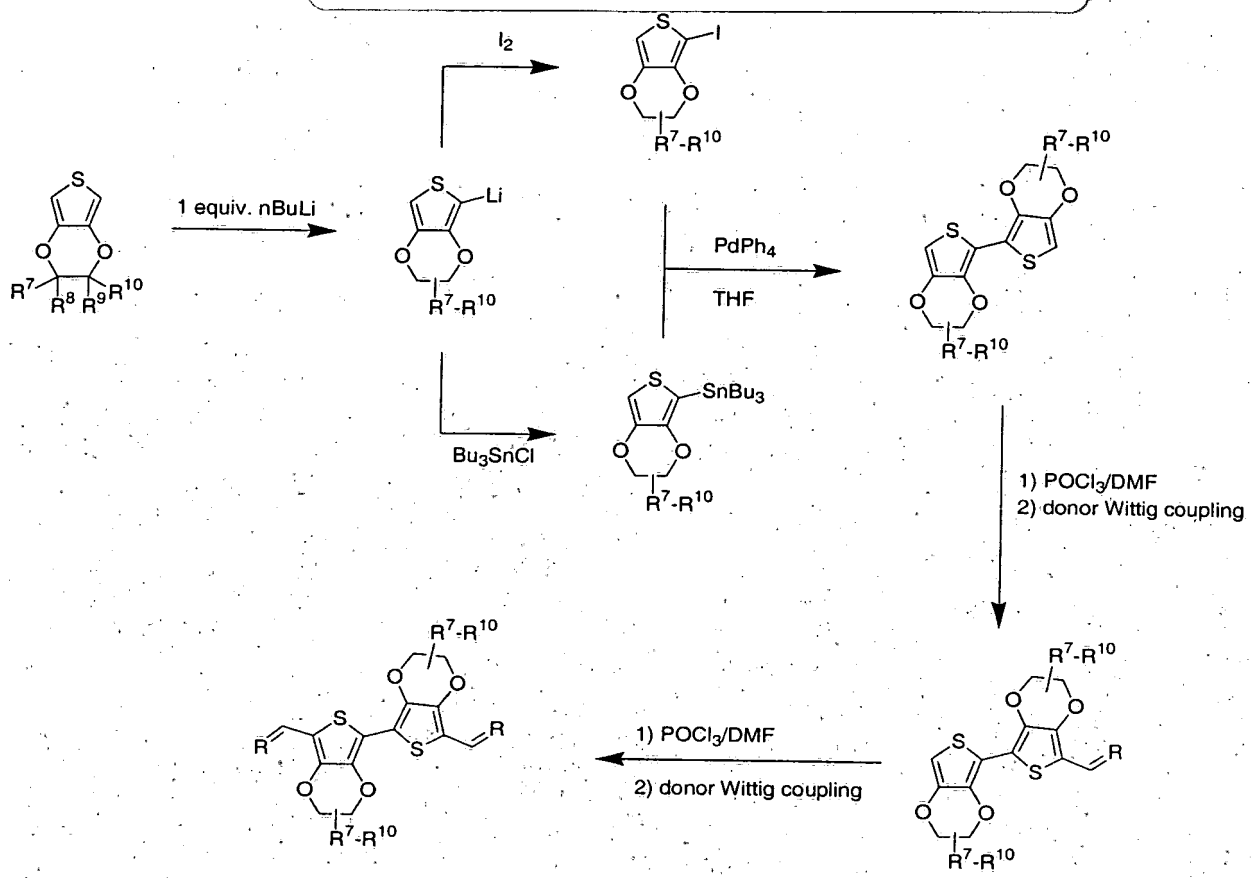
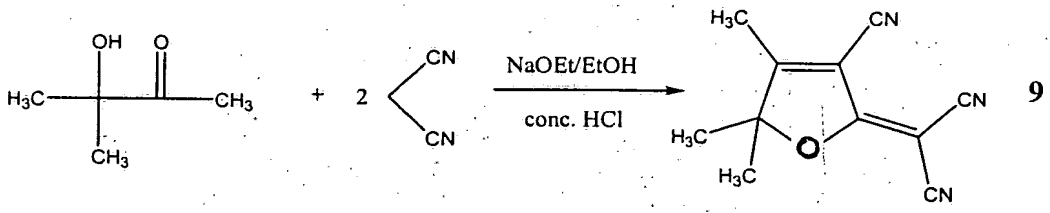


J. Am. Chem. Soc. 2001, 123(19), 4643
Chem. Mater. 1996, 8(11), 2659
J. Chem. Soc. Perkins Trans. I 1997, 1957

FIGURE 7



9

FIGURE 11

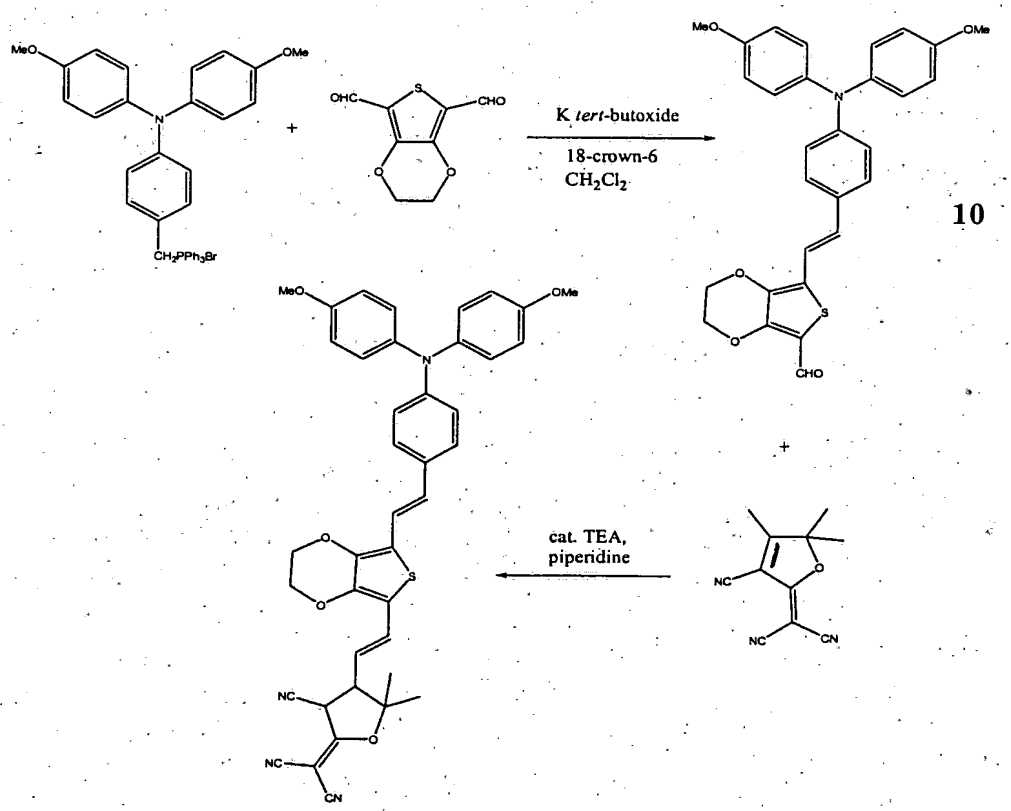


FIGURE 8

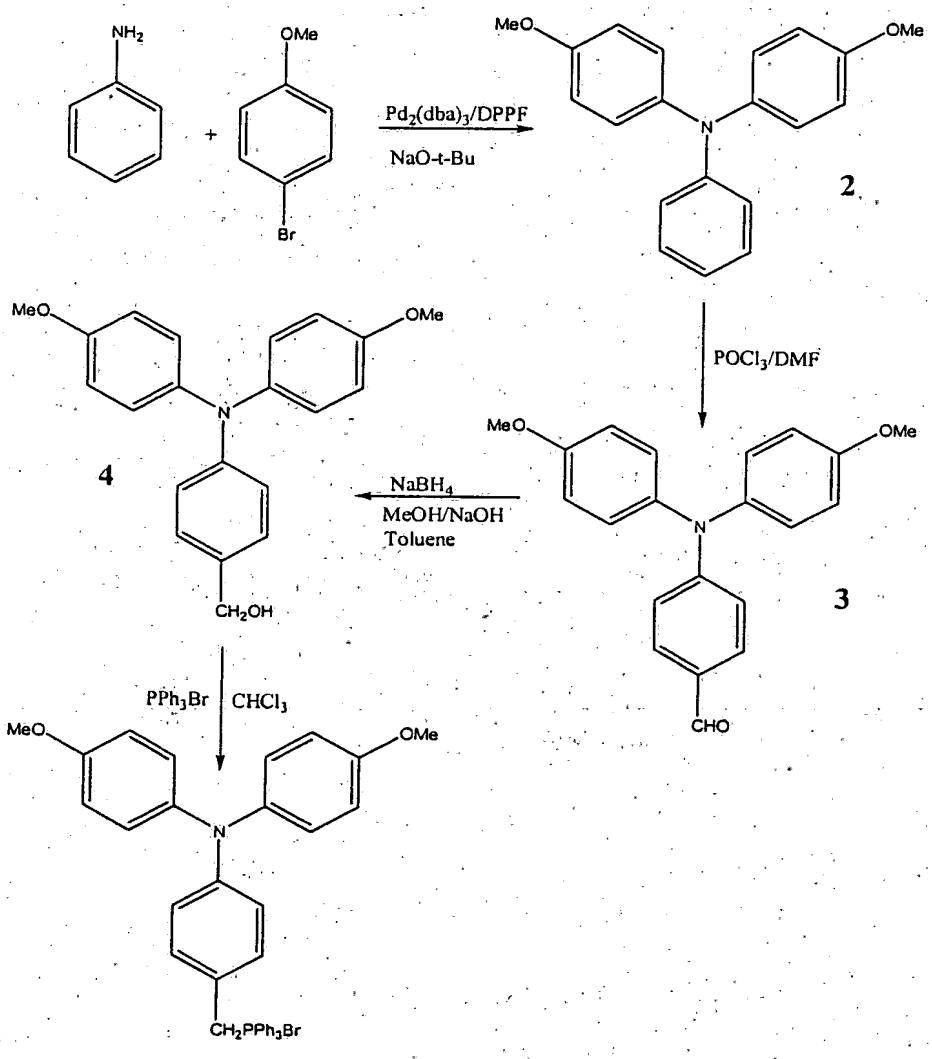

NH2
OMe
Br
Pd2(dba)3/DPPF
NaO-t-Bu
MeO
OMe
N
2
POCl3/DMF
CHO
3
NaBH4
MeOH/NaOH
Toluene
CH2OH
4
PPh3Br
CHCl3
CH2PPh3Br

FIGURE 9

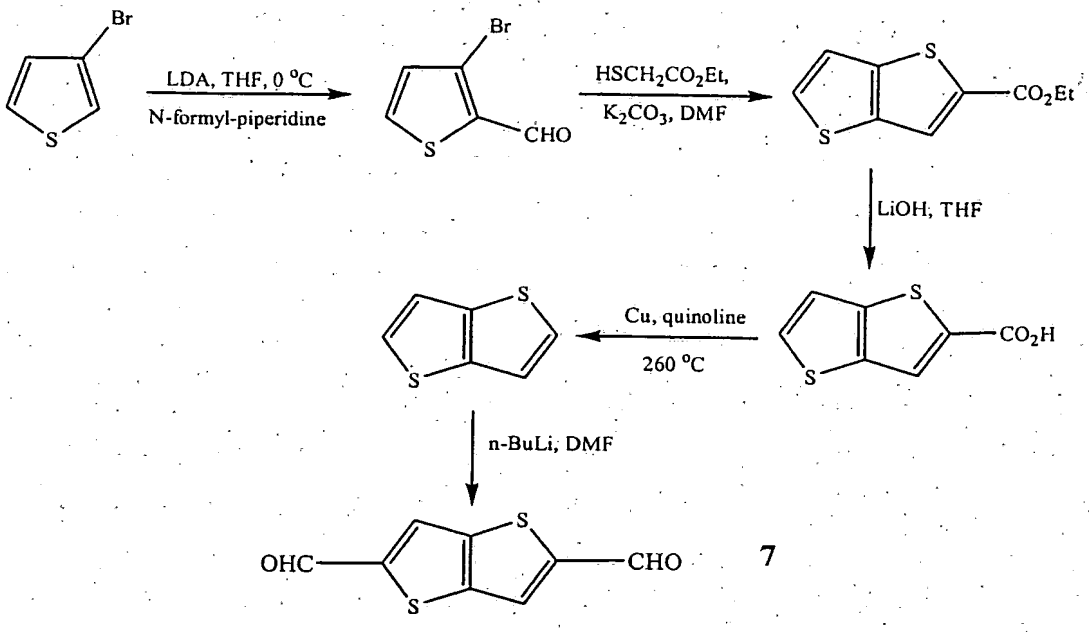


FIGURE 13

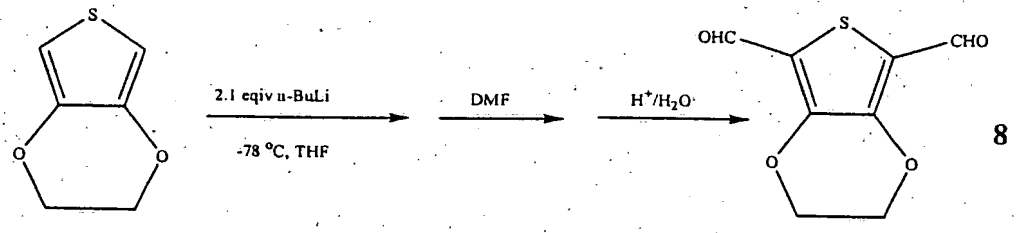


FIGURE 10

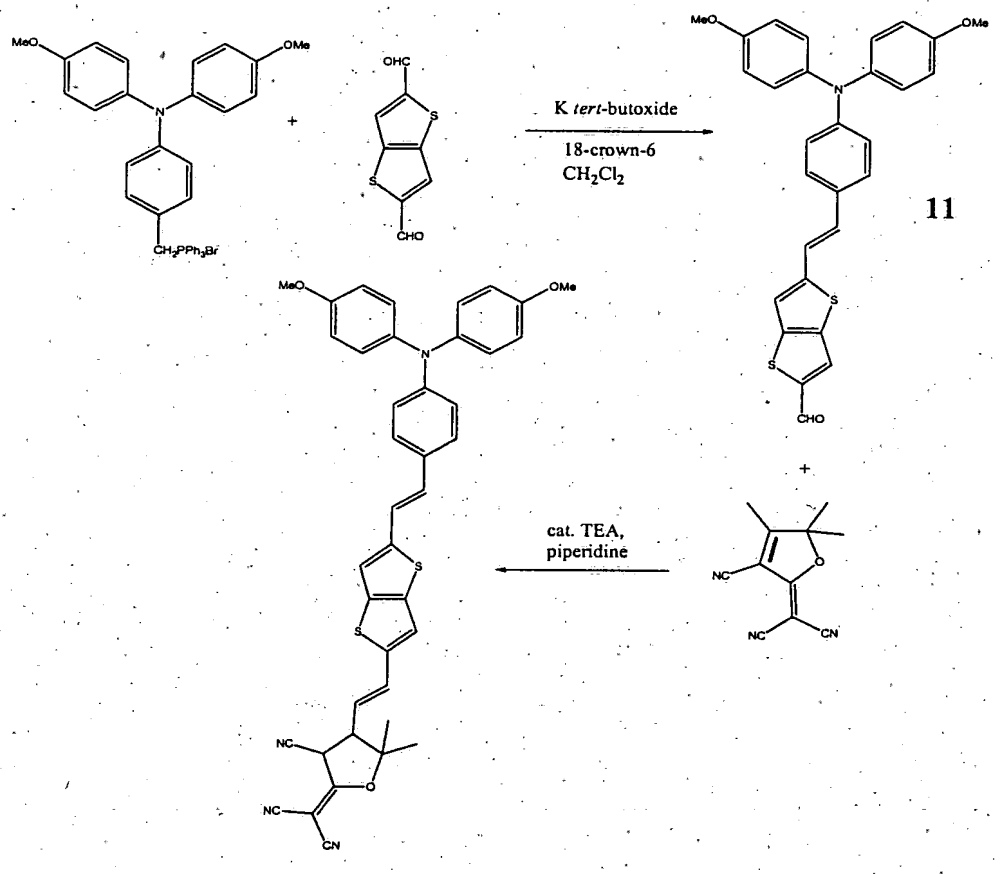

MeO
OMe
N
CH2PPh3Br
OHC
S
CHO
K tert-butoxide
18-crown-6
CH2Cl2
11
cat. TEA,
piperidine
NC
CN
O

FIGURE 12

Ti[redacted] HYPERPOLARIZABLE ORGANIC CHRO[redacted]HORES
In[redacted]rs: L.R. Dalton et al.
Docket No.: UOFW117403

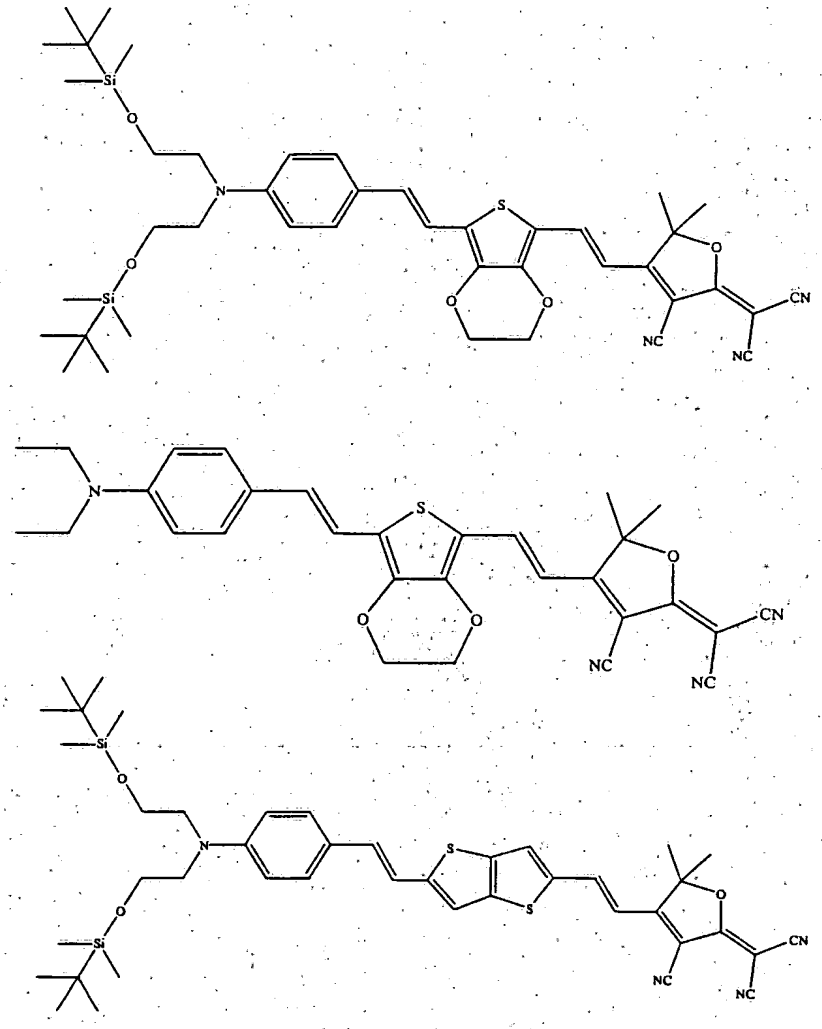


FIGURE 14

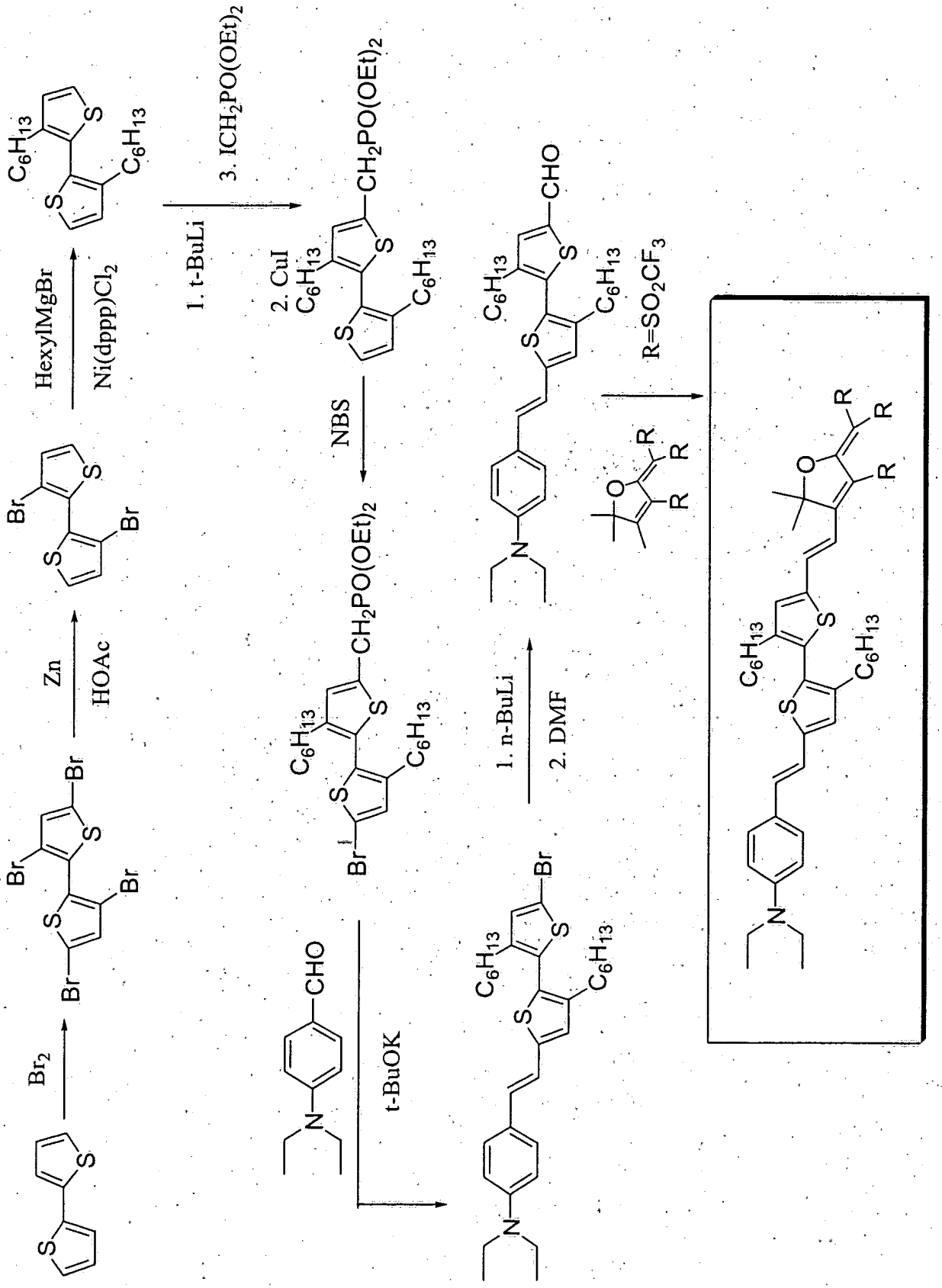

Br2
Zn
HOAc
HexylMgBr
Ni(dppp)Cl2
1. t-BuLi
3. ICH2PO(OEt)2
2. CuI
NBS
t-BuOK
1. n-BuLi
2. DMF
R=SO2CF3
C6H13
CHO
CH2PO(OEt)2
Br
R
O
N
S

FIGURE 15

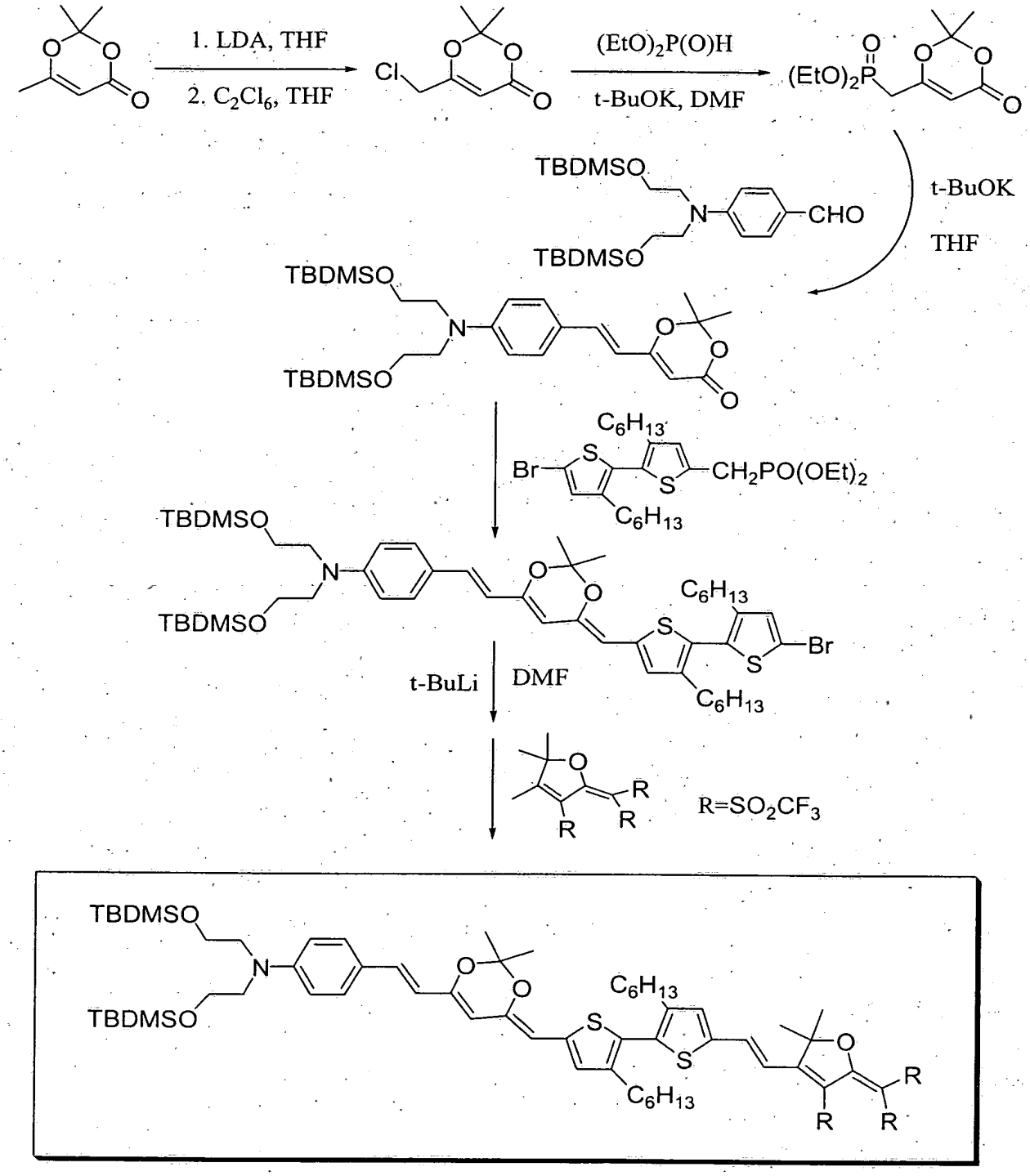
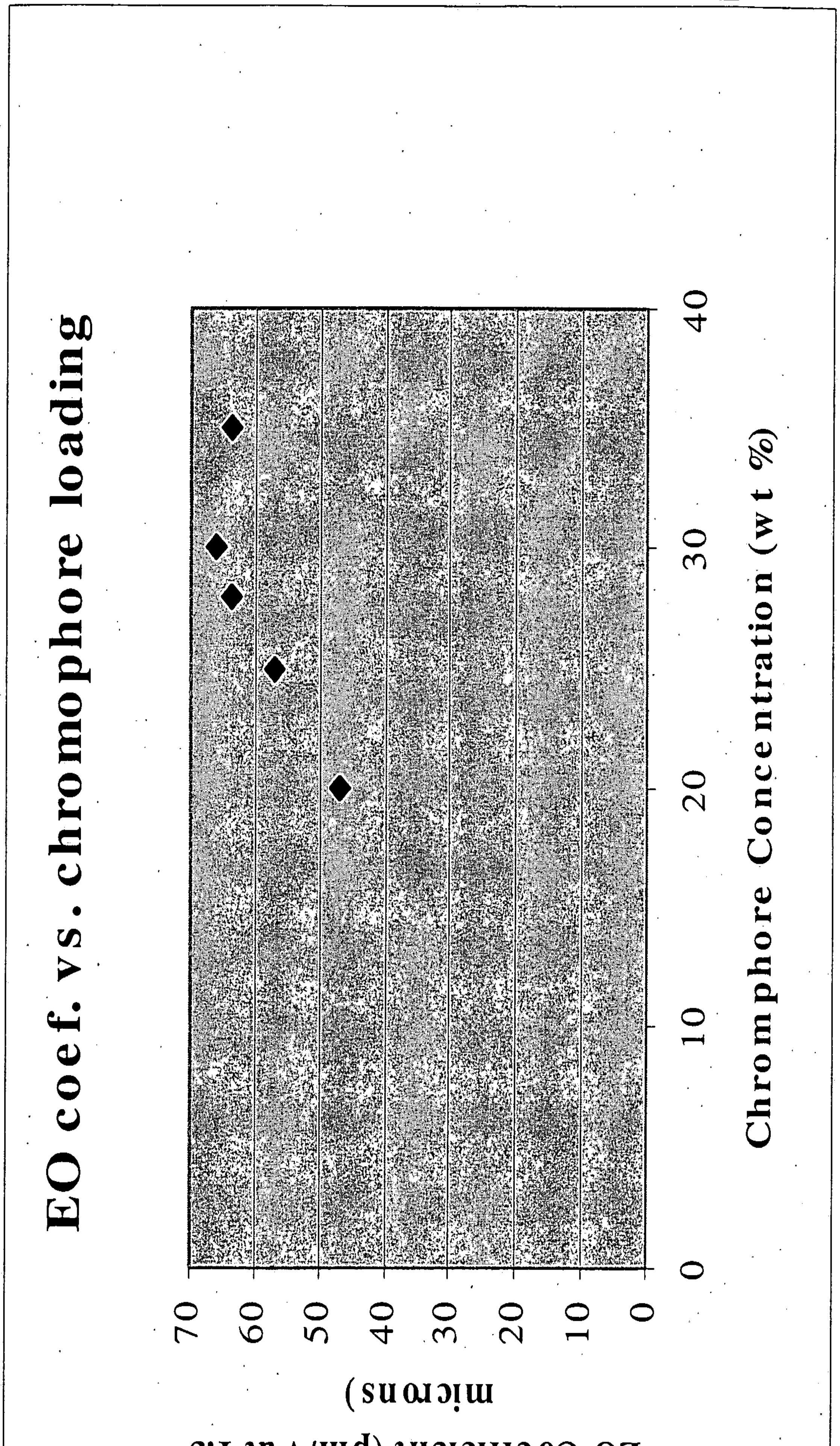

1. LDA, THF
2. C_2Cl_6, THF
$(EtO)_2P(O)H$
t-BuOK, DMF
t-BuOK
THF
TBDMSO
TBDMSO
CHO
C_6H_{13}
Br
$CH_2PO(OEt)_2$
t-BuLi
DMF
R=SO_2CF_3

FIGURE 17

Title: HYPERPOLARIZABLE ORGANIC CHROMOPHORES
I[redacted]tors: L.R. Dalton et al.
[redacted]t No.: UOFW117403



Title: HYPERPOLARIZABLE ORGANIC CHRO[illegible]OPHORES
[illegible]ntors: L.R. Dalton et al.
Docket No.: UOFW117403

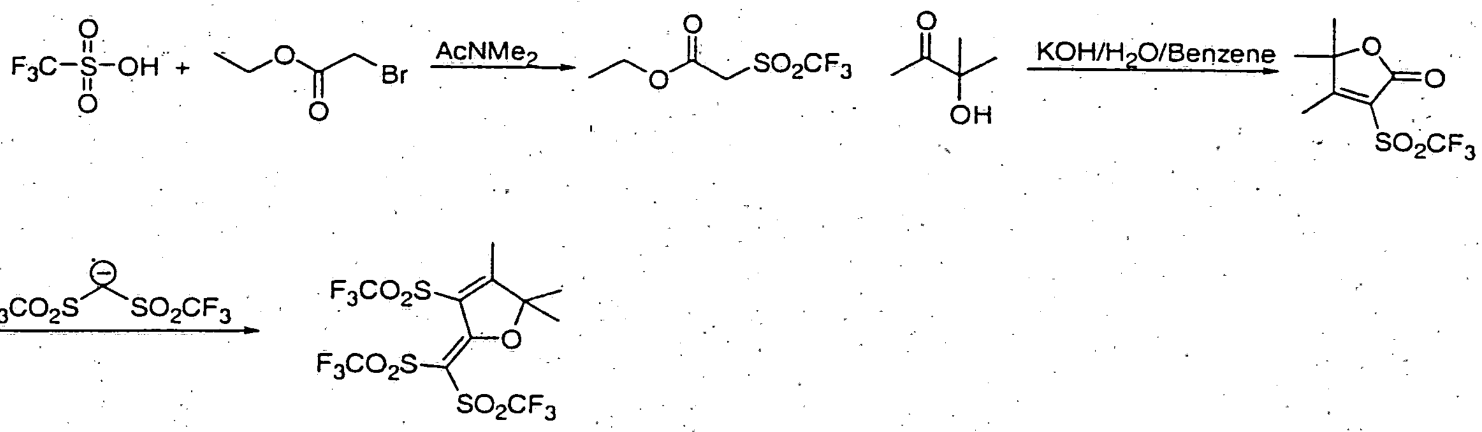


FIGURE 16

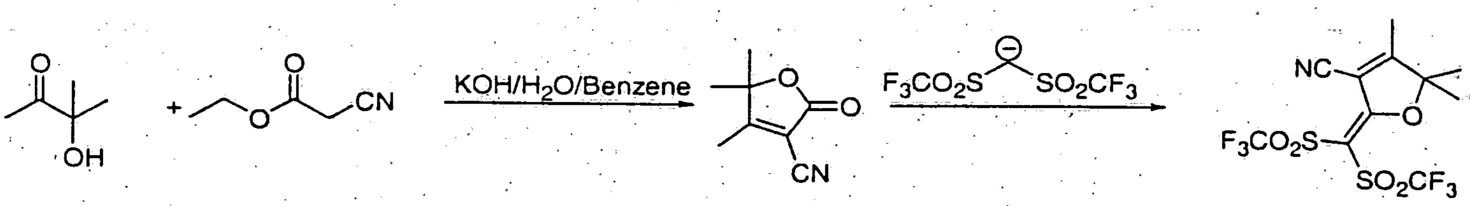


FIGURE 19

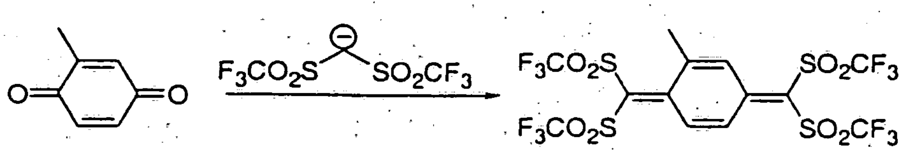


FIGURE 20

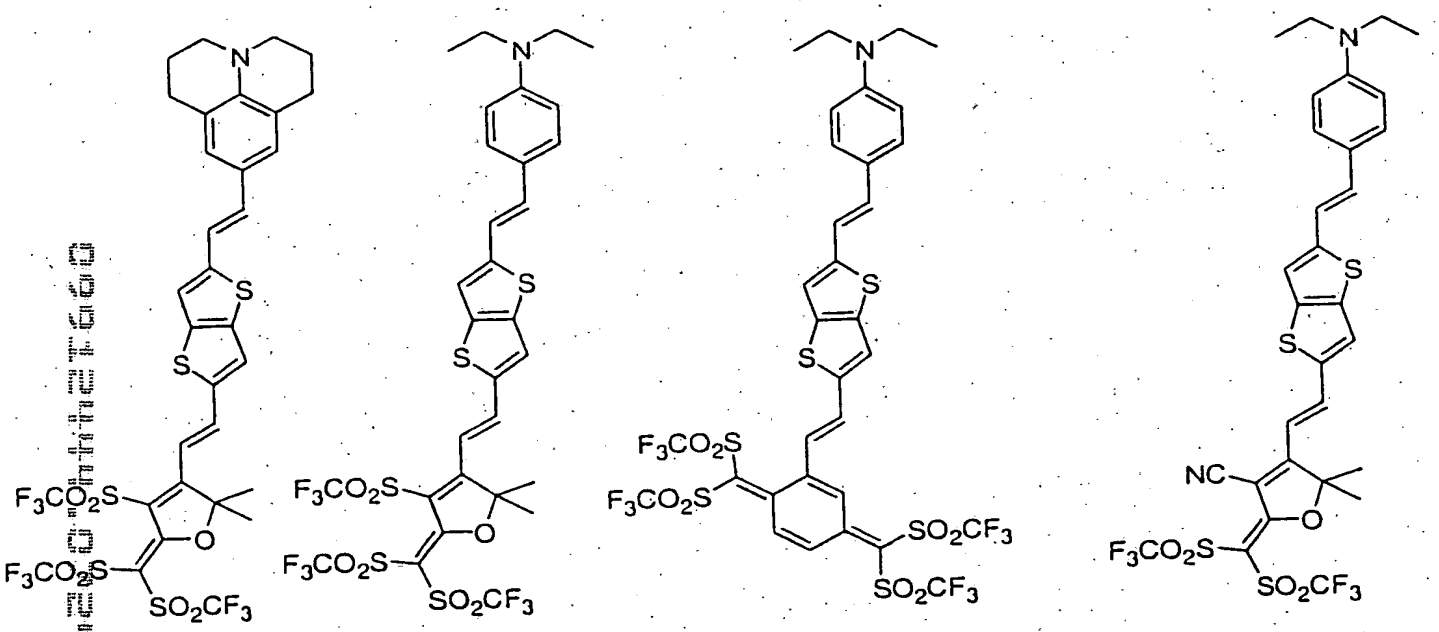


FIGURE 21

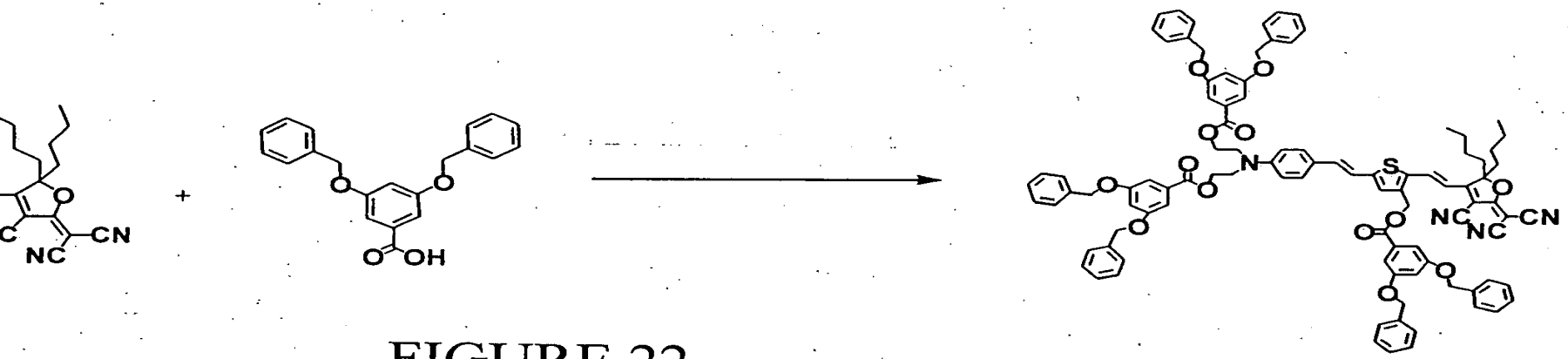


FIGURE 22

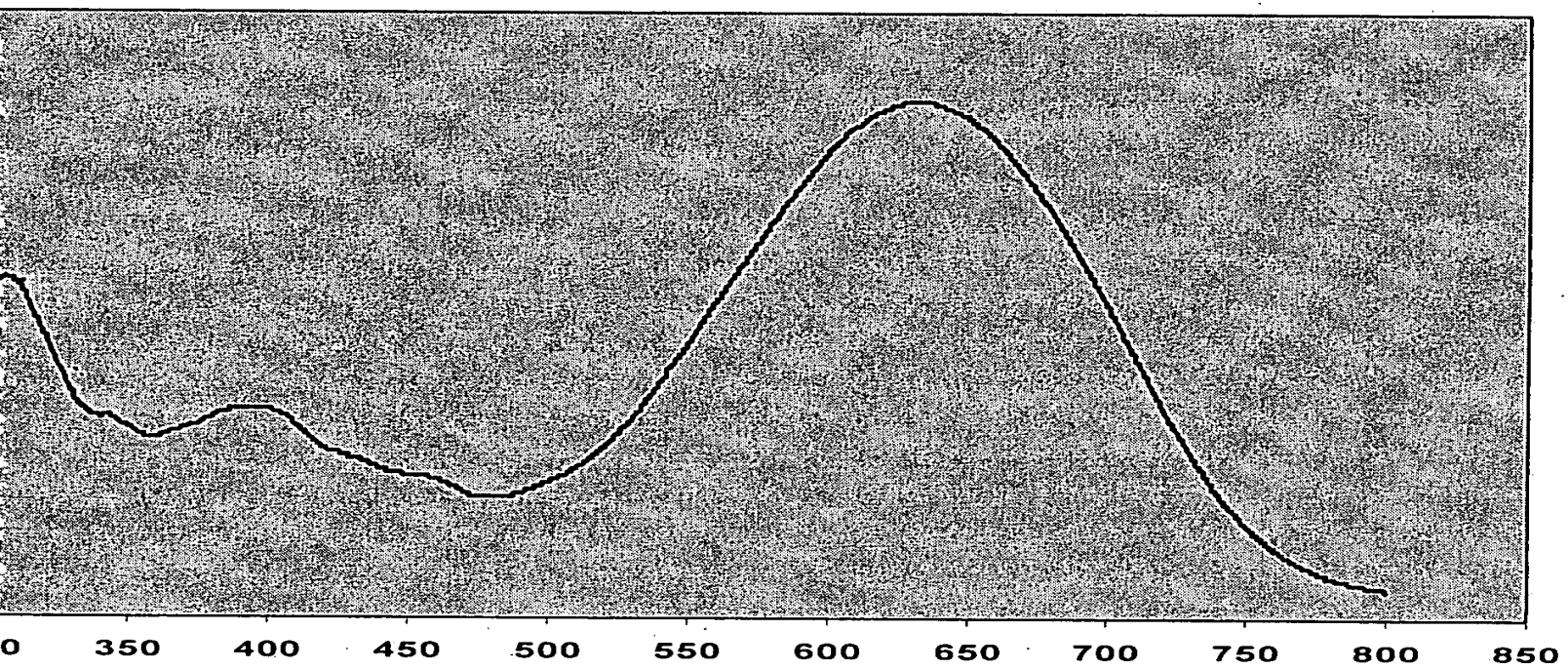


FIGURE 24

Title: HYPERPOLARIZABLE ORGANIC CHROMOPHORES
Inventors: L.R. Dalton et al.
Docket No.: UOFW11403

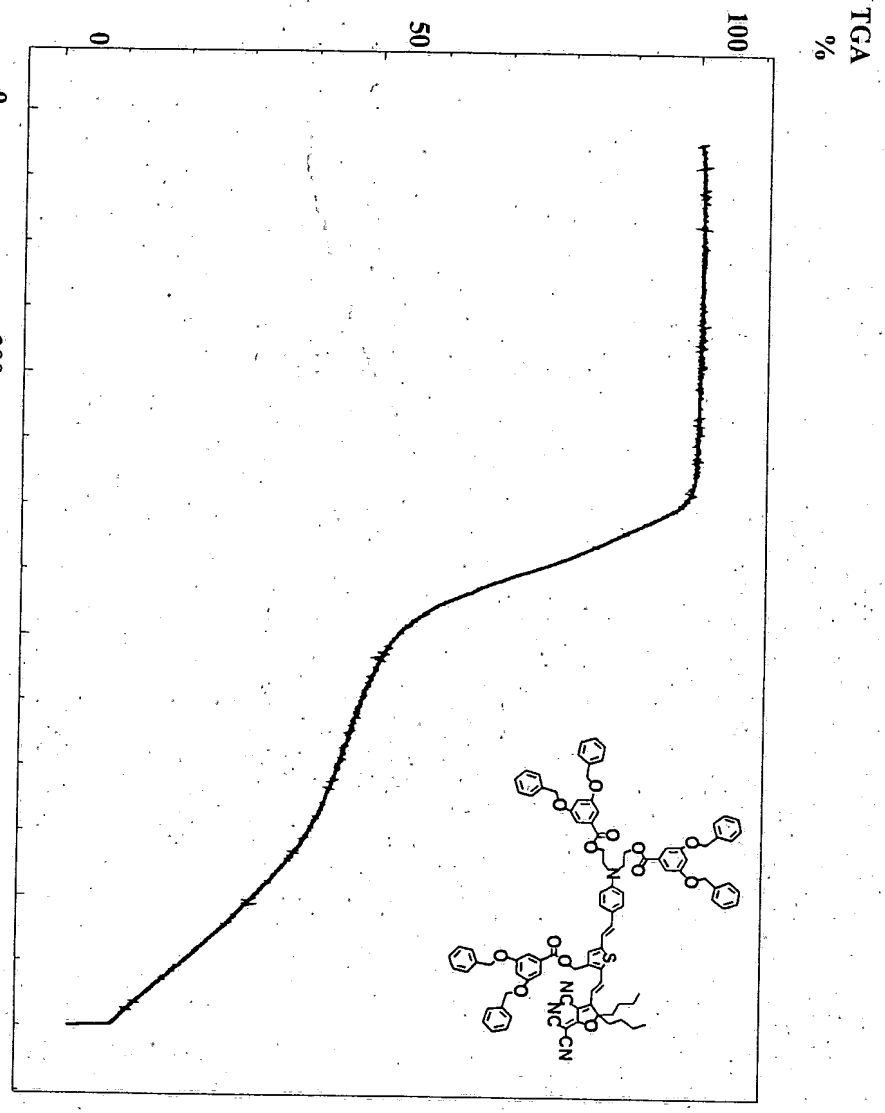


FIGURE 23

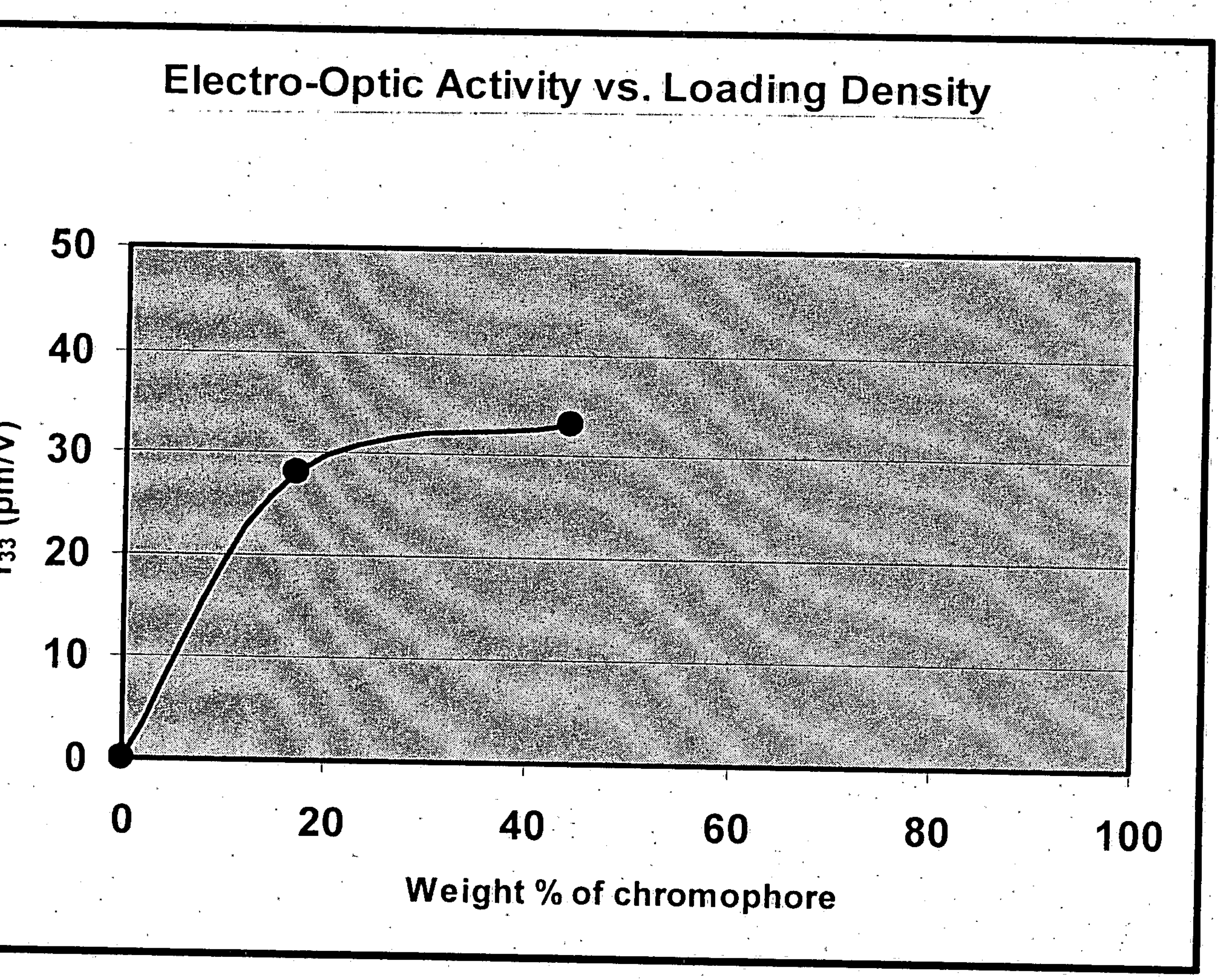

Electro-Optic Activity vs. Loading Density
50
40
30
20
10
0
0
20
40
60
80
100
Weight % of chromophore

FIGURE 25

T[redacted] HYPERPOLARIZABLE ORGANIC CHRO[redacted]HORES
I[redacted]ors: L.R. Dalton et al.
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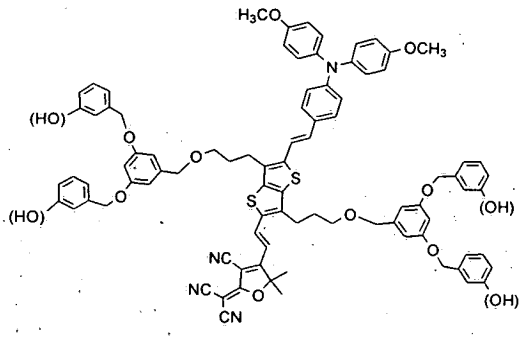


FIGURE 26

HYPERPOLARIZABLE ORGANIC CHRO[redacted]PHORES
[redacted]tors: L.R. Dalton et al.
Docket No.: UOFW117403

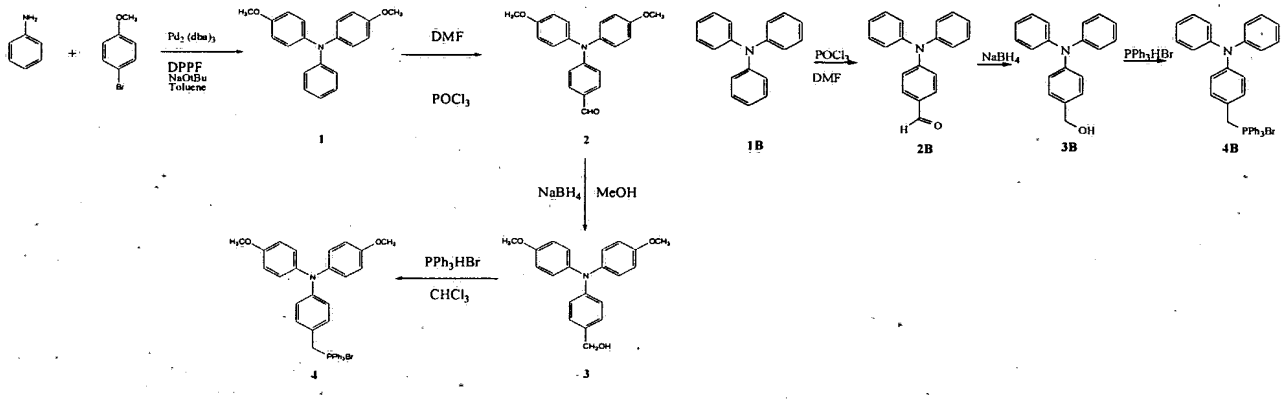


FIGURE 27

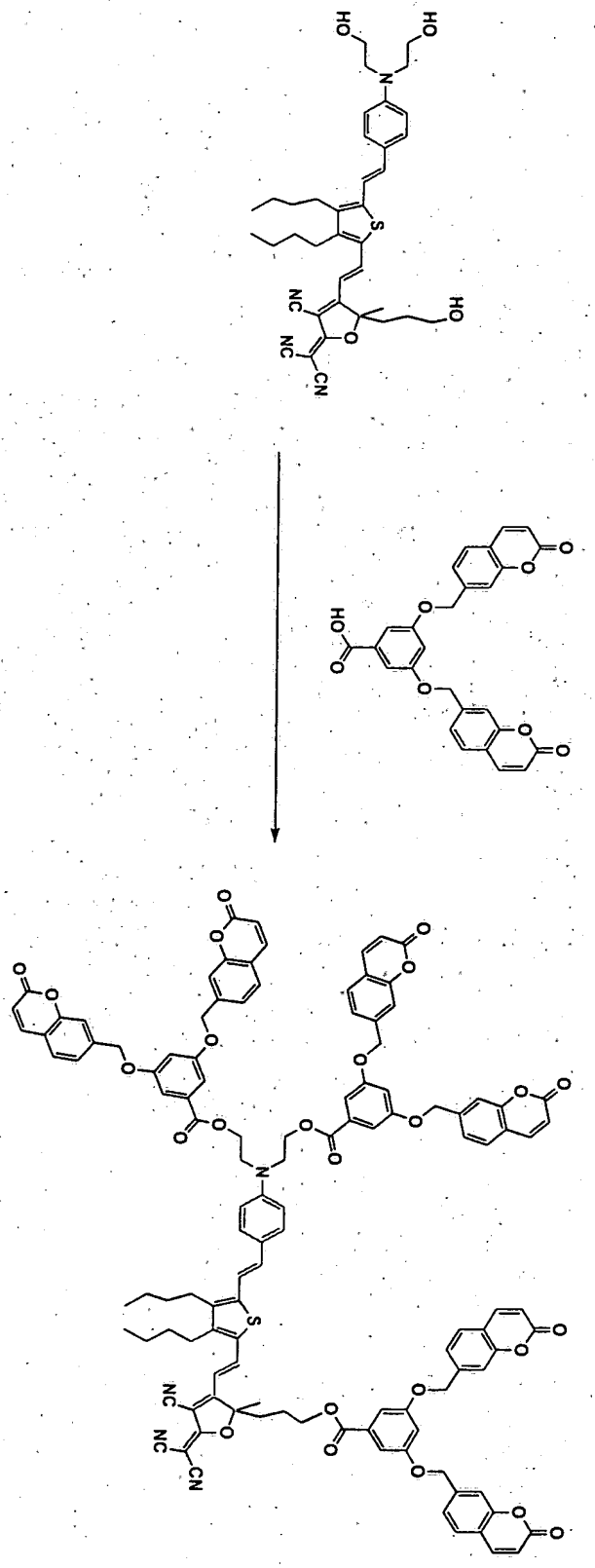


FIGURE 28

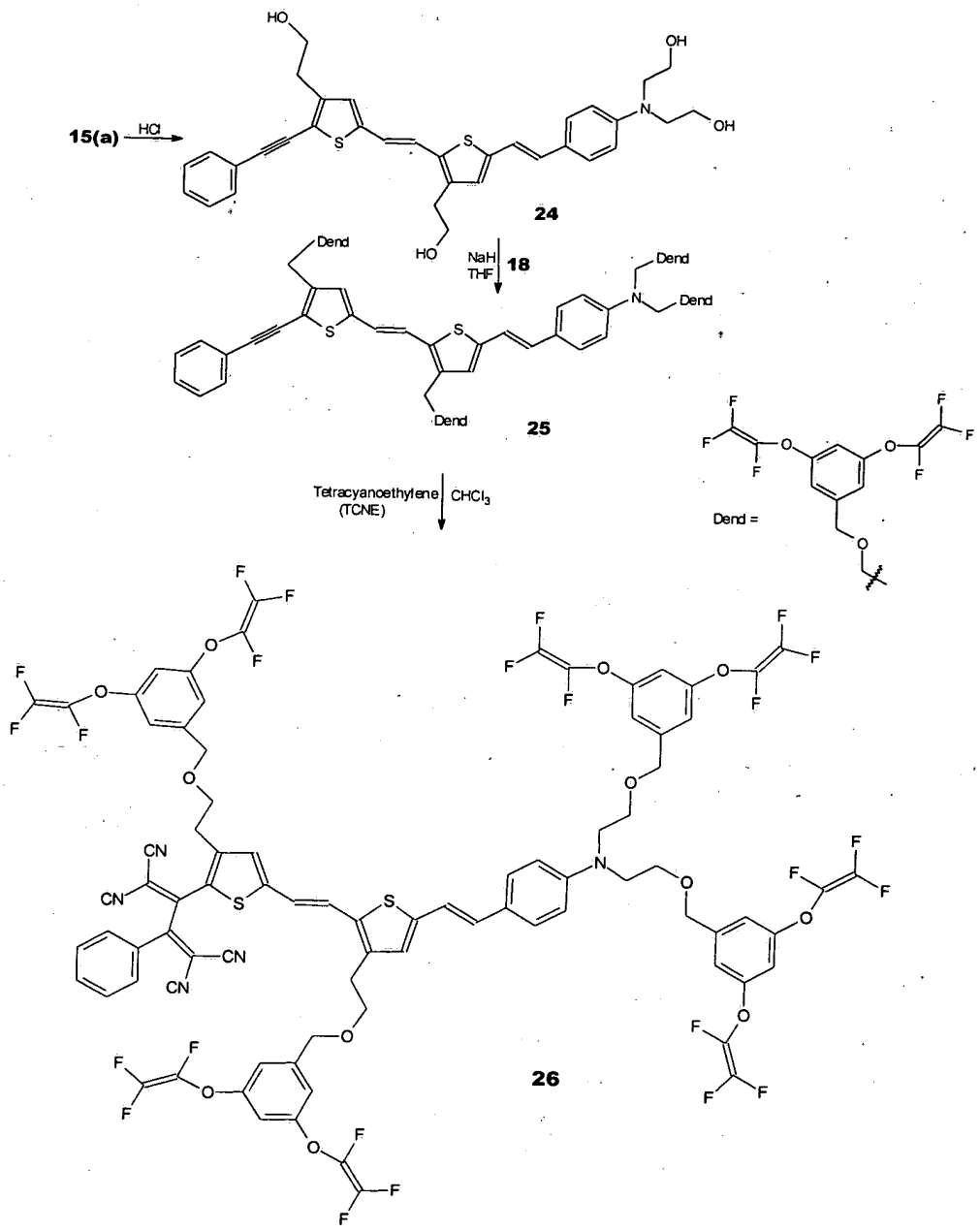
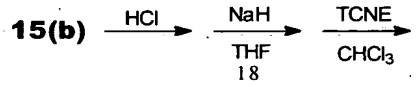

15(a)
HCl
24
NaH
THF
18
25
Tetracyanoethylene
(TCNE)
CHCl3
Dend =
26

FIGURE 29



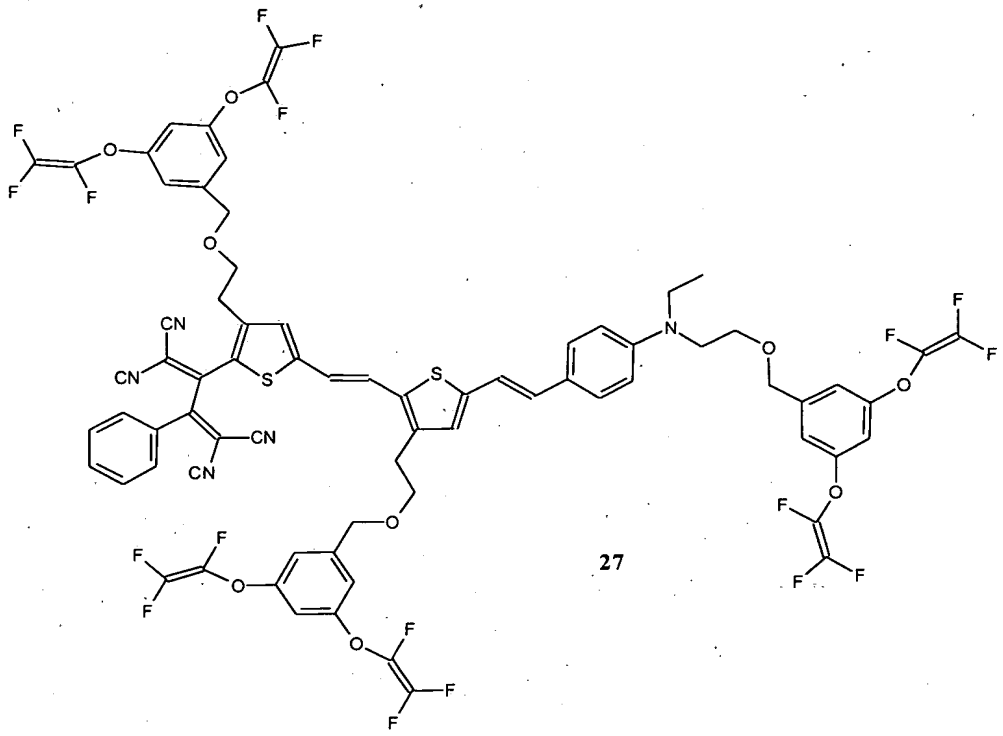
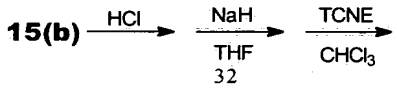
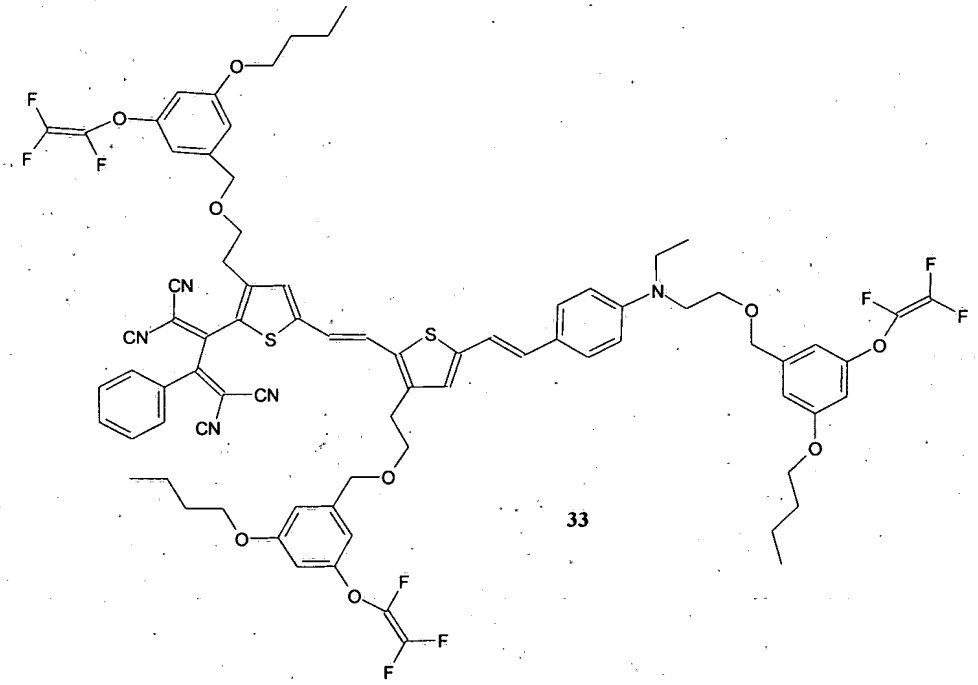


FIGURE 30



32



33

FIGURE 31

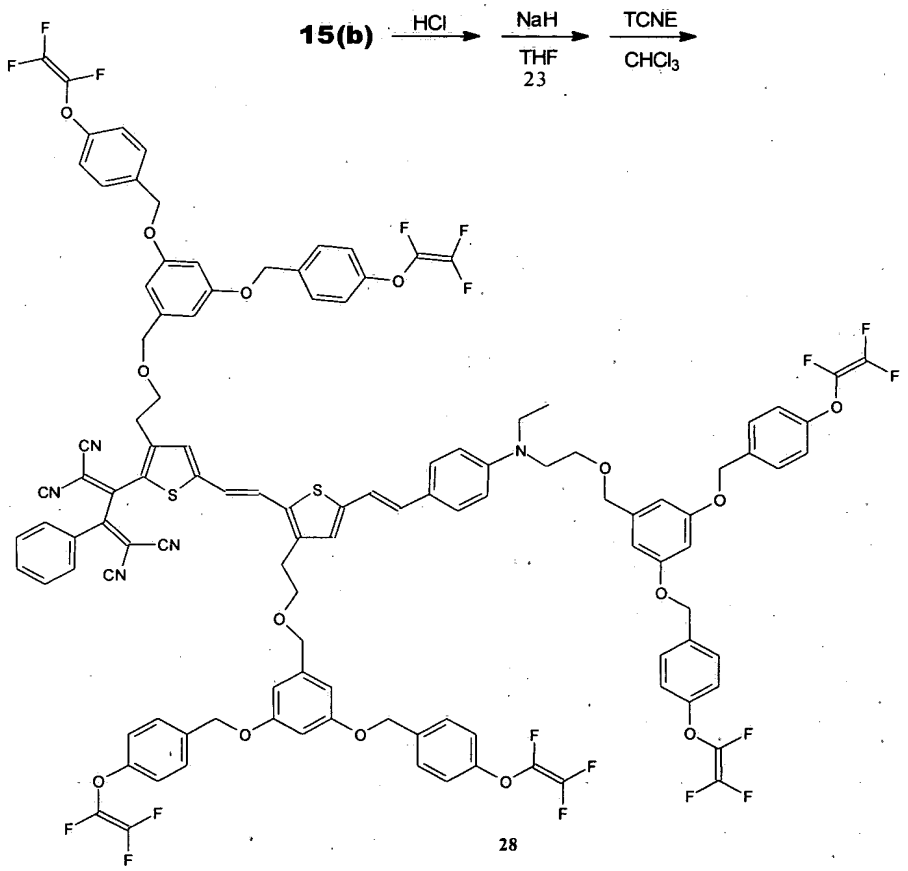


FIGURE 32

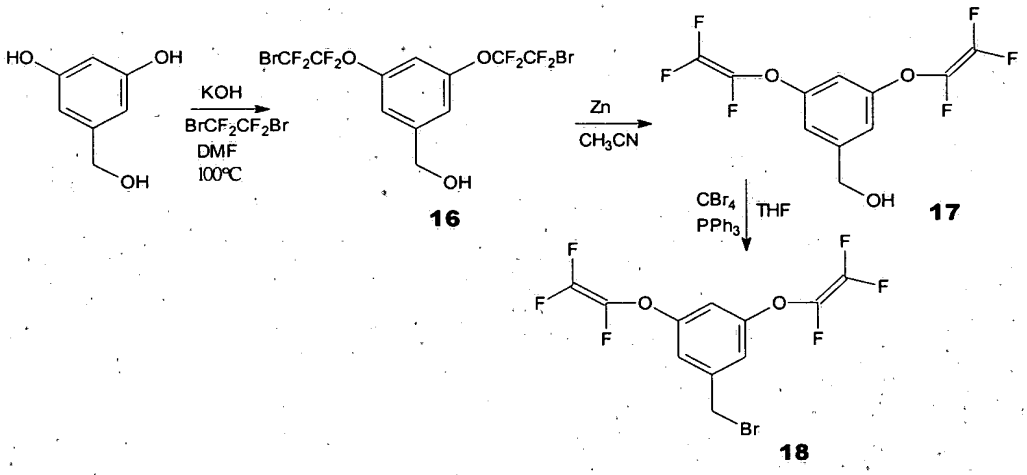

HO
OH
OH
KOH
$BrCF_2CF_2Br$
DMF
100°C
$BrCF_2CF_2O$
OCF_2CF_2Br
OH
16
Zn
CH_3CN
F
O
OH
17
CBr_4
PPh_3
THF
Br
18

FIGURE 33

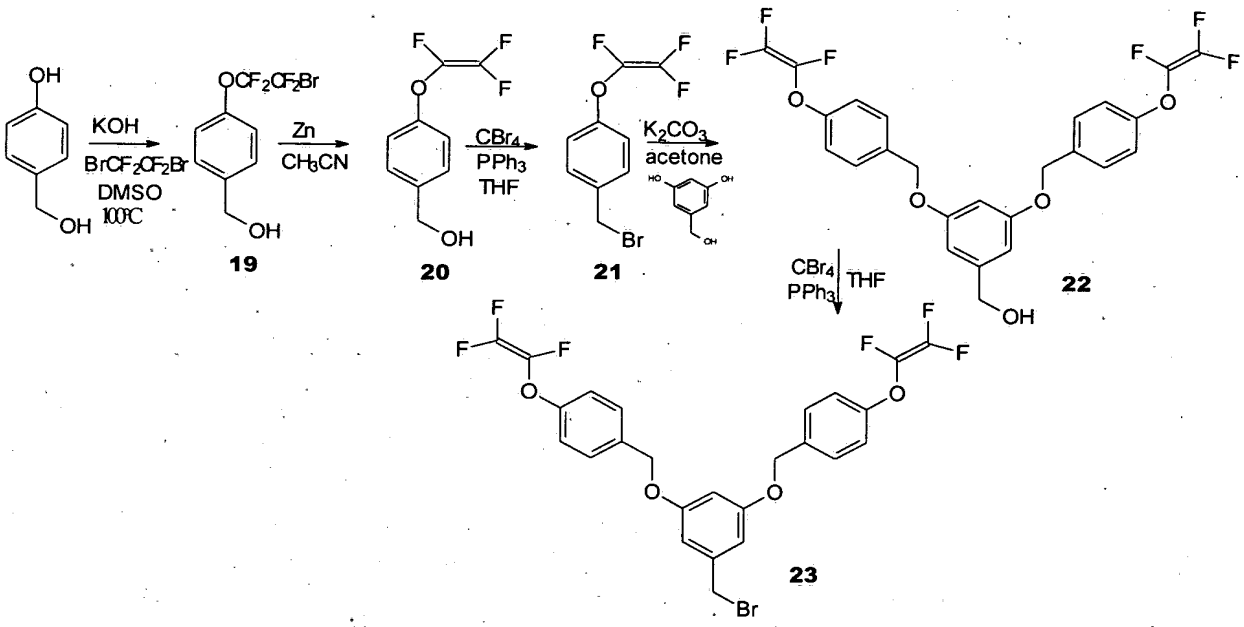

OH
KOH
BrCF2CF2Br
DMSO
100°C
OCF2CF2Br
OH
19
Zn
CH3CN
F
F
F
O
OH
20
CBr4
PPh3
THF
Br
21
K2CO3
acetone
HO
OH
22
CBr4
PPh3
THF
23
Br

FIGURE 34

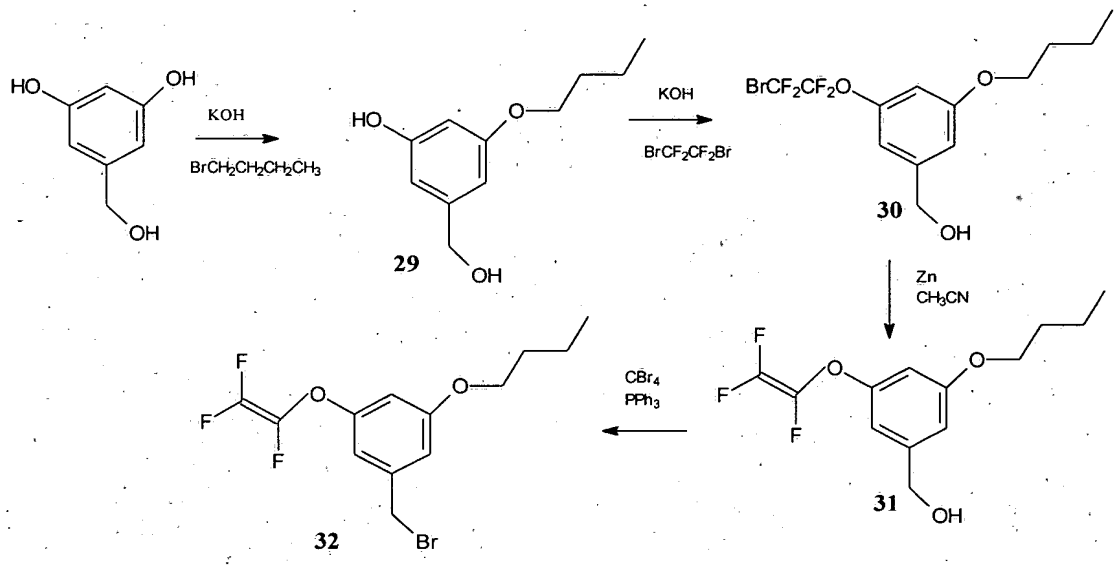

HO
OH
KOH
BrCH2CH2CH2CH3
OH
29
HO
KOH
BrCF2CF2Br
BrCF2CF2O
O
30
OH
Zn
CH3CN
F
F
O
O
31
OH
CBr4
PPh3
F
F
O
O
32
Br

FIGURE 35

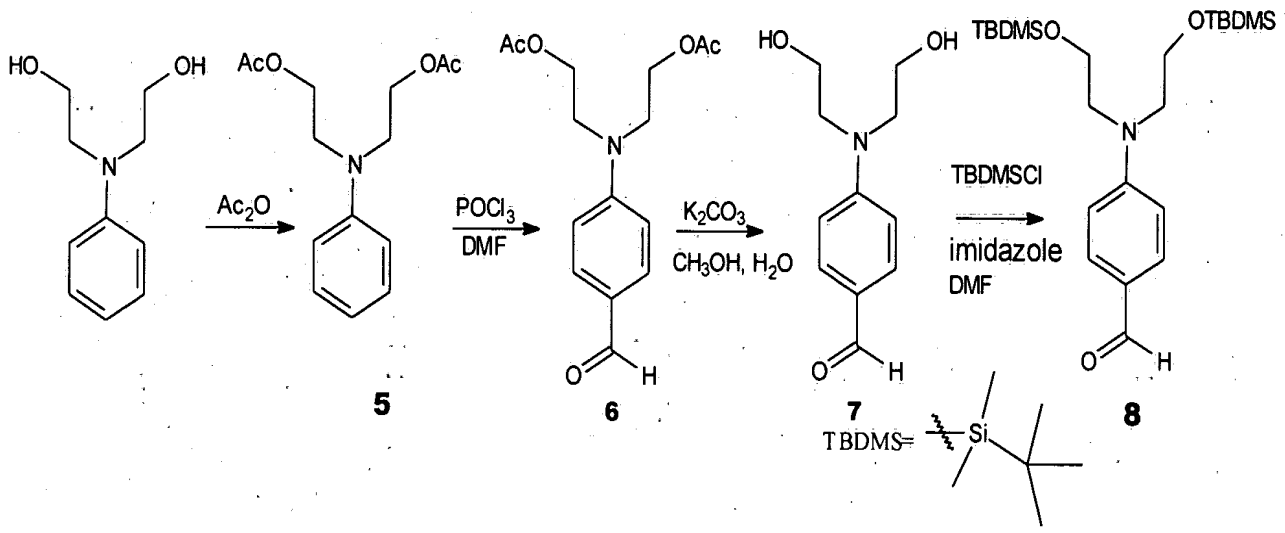


FIGURE 36

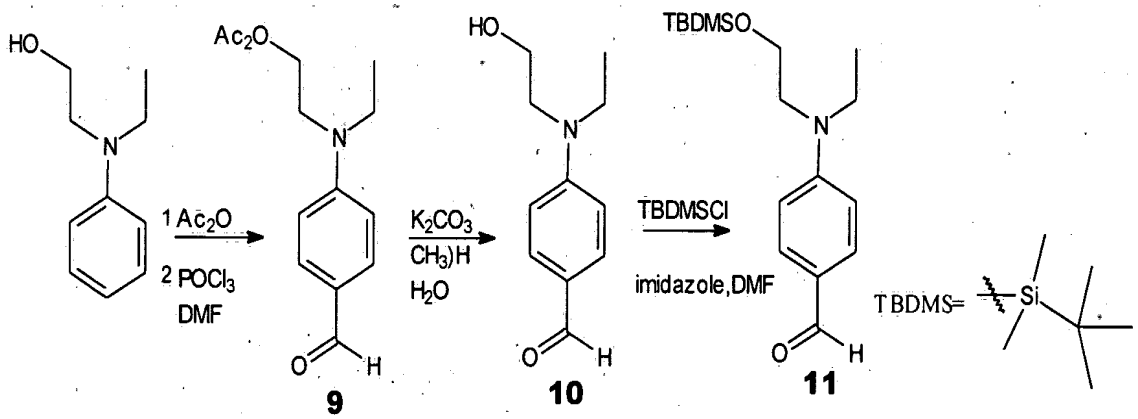
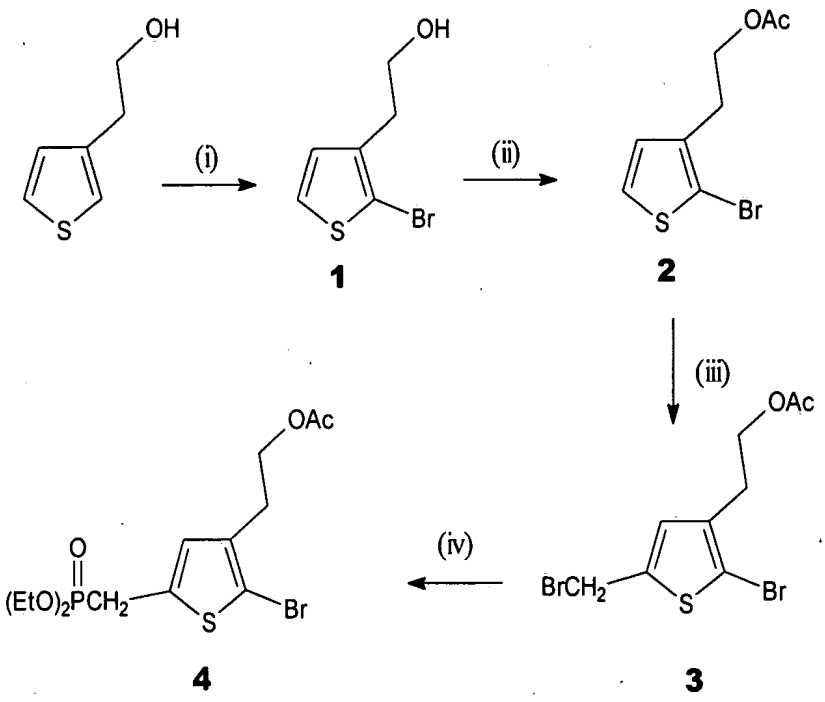
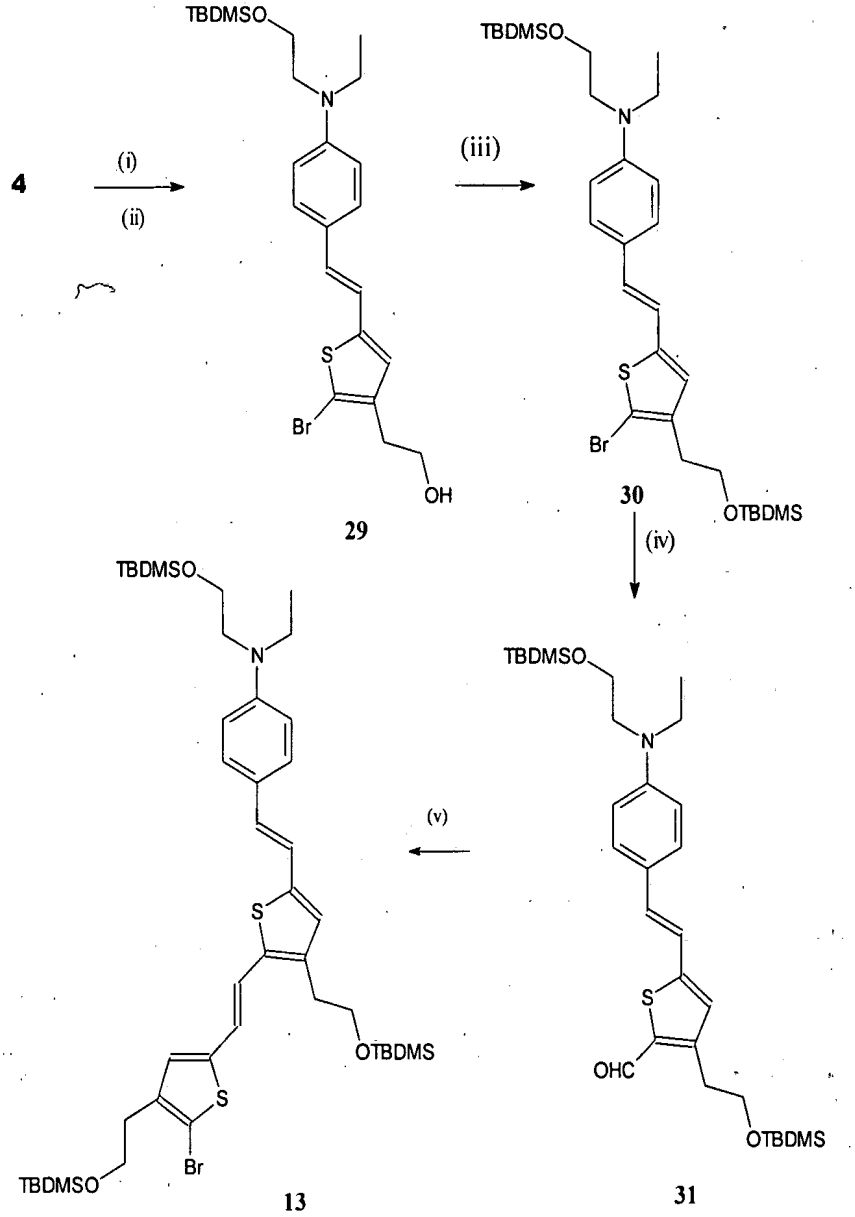


FIGURE 37



(i) NBS, DMF, RT;(ii) acetic anhydride, 60°C; (iii) $(CH_2O)n$, 45% HBr/HOAc, HOAc, 50°C; (iv) $P(OEt)_3$, DMF, 120°C.

FIGURE 38



(i) 11, KOtBu, THF, 0°C; (ii) K_2CO_3, CH_3OH, H_2O, RT; (iii) $(CH_3)_3CSi(CH_3)_2Cl$, imidazole, DMF, 50°C; (iv) a. nBu-Li, THF, -78°C; b. DMF, RT; (v) a. 4, KOtBu, THF, 0°C; b. K_2CO_3, CH_3OH, H_2O, RT; c. $(CH_3)_3CSi(CH_3)_2Cl$, imidazole, DMF, 50°C.

FIGURE 39

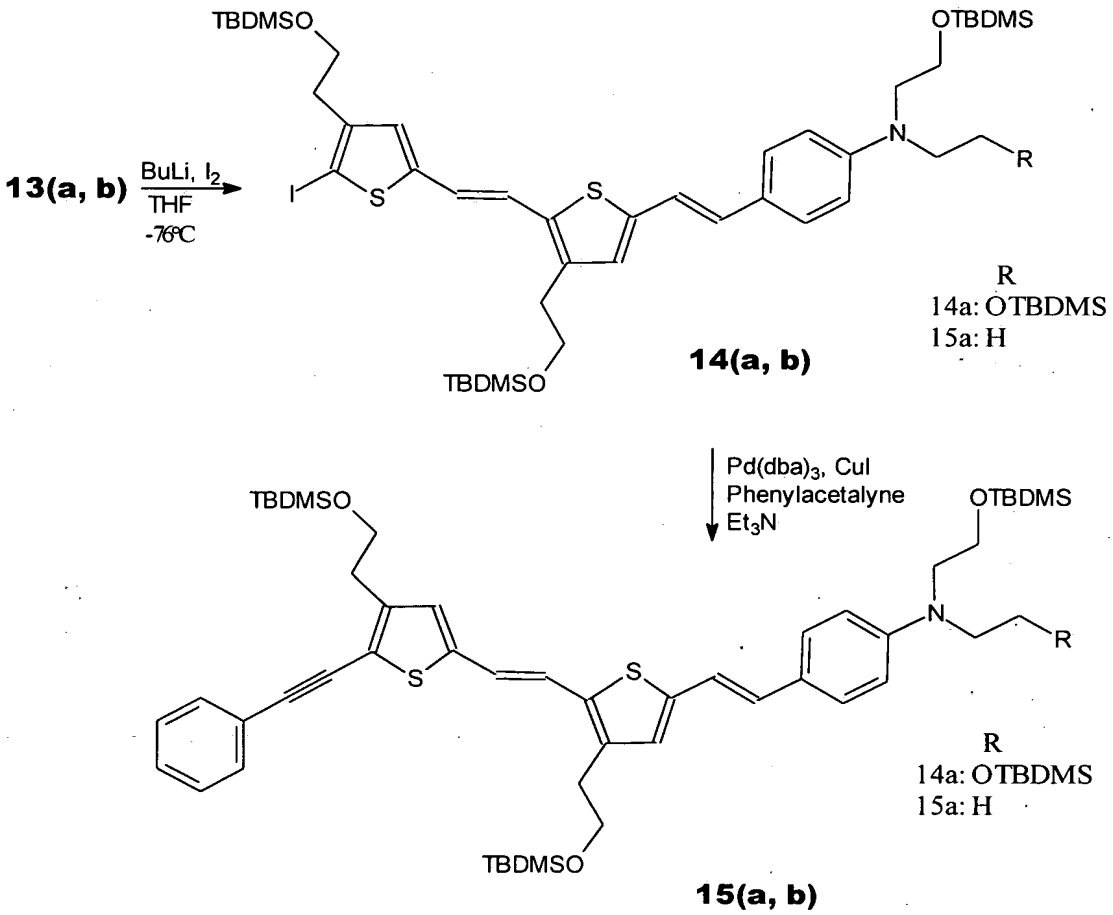

TBDMSO
OTBDMS
13(a, b)
BuLi, I2
THF
-76°C
I
S
S
N
R
TBDMSO
R
14a: OTBDMS
15a: H
14(a, b)
Pd(dba)3, CuI
Phenylacetalyne
Et3N
TBDMSO
OTBDMS
S
S
N
R
TBDMSO
R
14a: OTBDMS
15a: H
15(a, b)

FIGURE 40

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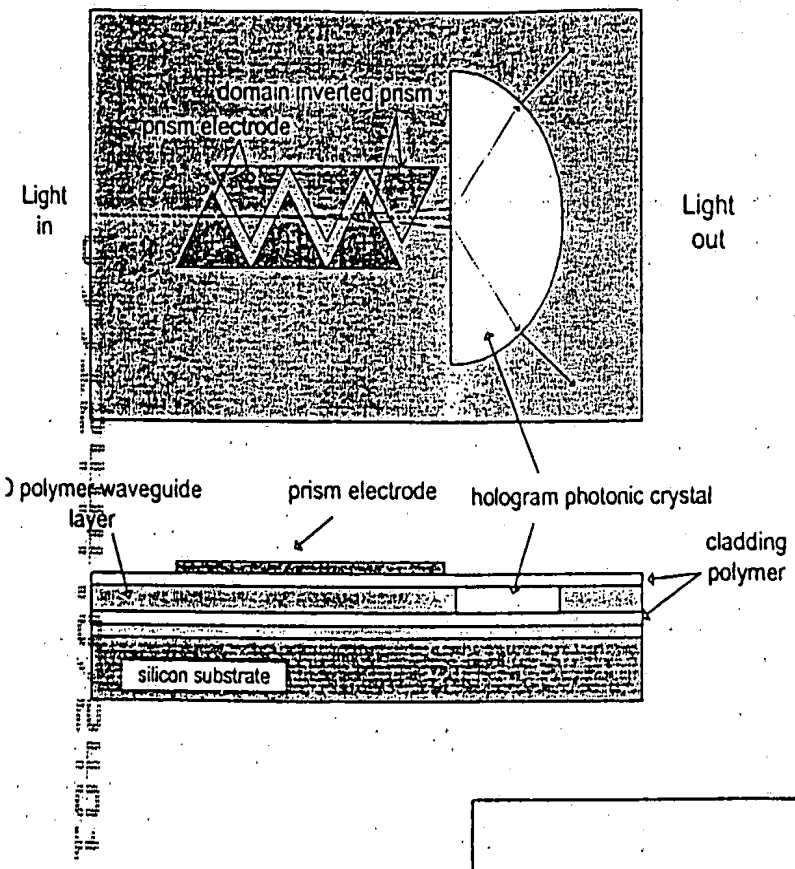
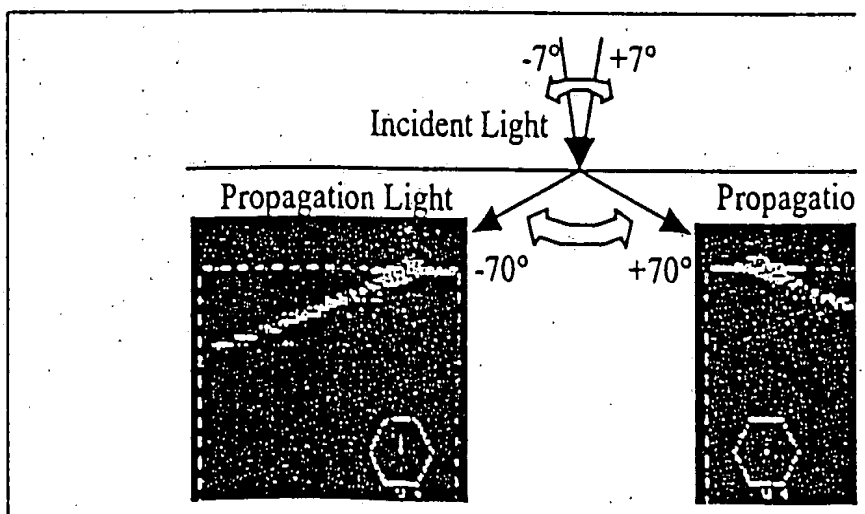
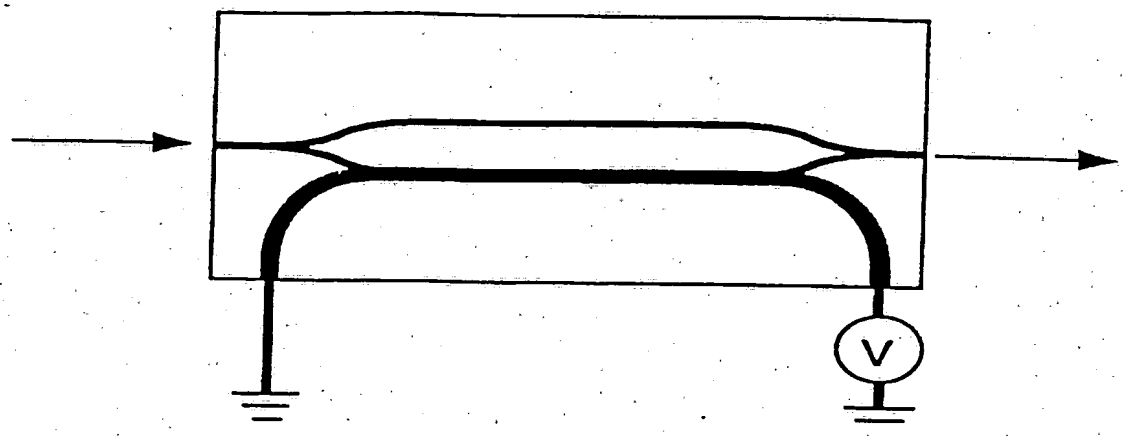
Large Angle Laser Beam Scanner

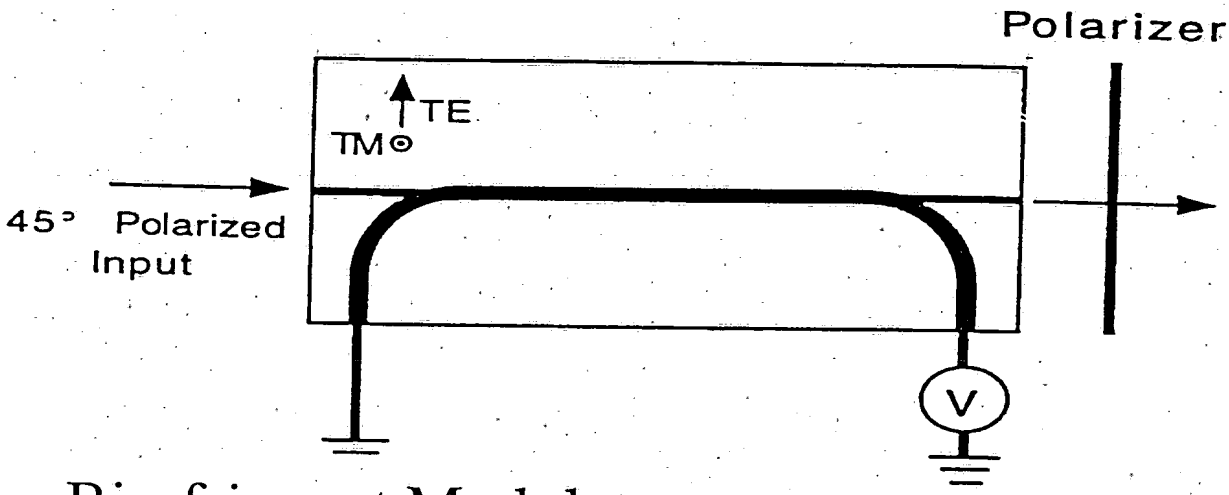


EO waveguide prism introduces a small deflection angle to initialize the beam scanning. The half-circle 2-D photonic crystal region is imbedded into the waveguide, so that the deflection angle is "amplified" as the light pass through the crystal region. 3D scanning can also be provided if a 3-D structure is built

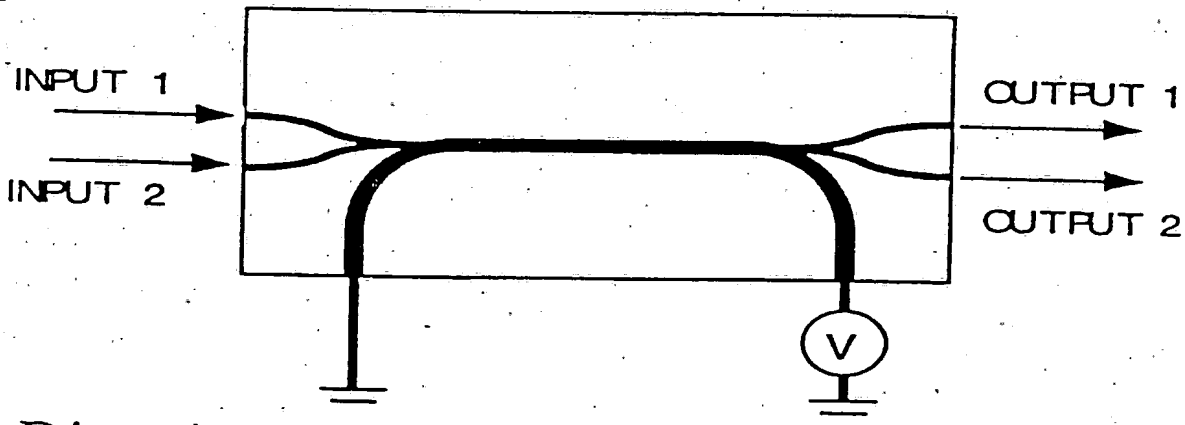




Mach Zehnder Modulator



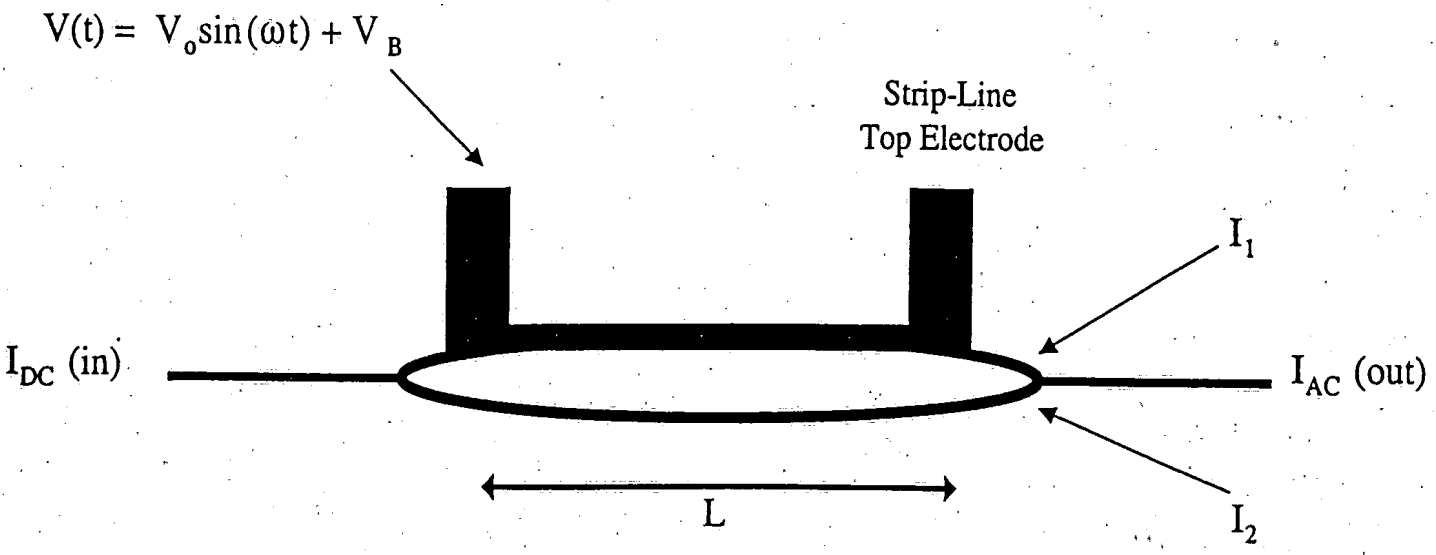
Birefringent Modulator



Directional Coupler

FIGURE 42

Title: HYPERPOLARIZABLE ORGANIC CHROMOPHORES
Inventor: L.R. Dalton et al.
Doc. No.: UOFW117403



$$I_{AC}(out) = I_1 + I_2 + 2(I_1 I_2)^{1/2} \sin(\rho V_o \sin(\omega t))$$

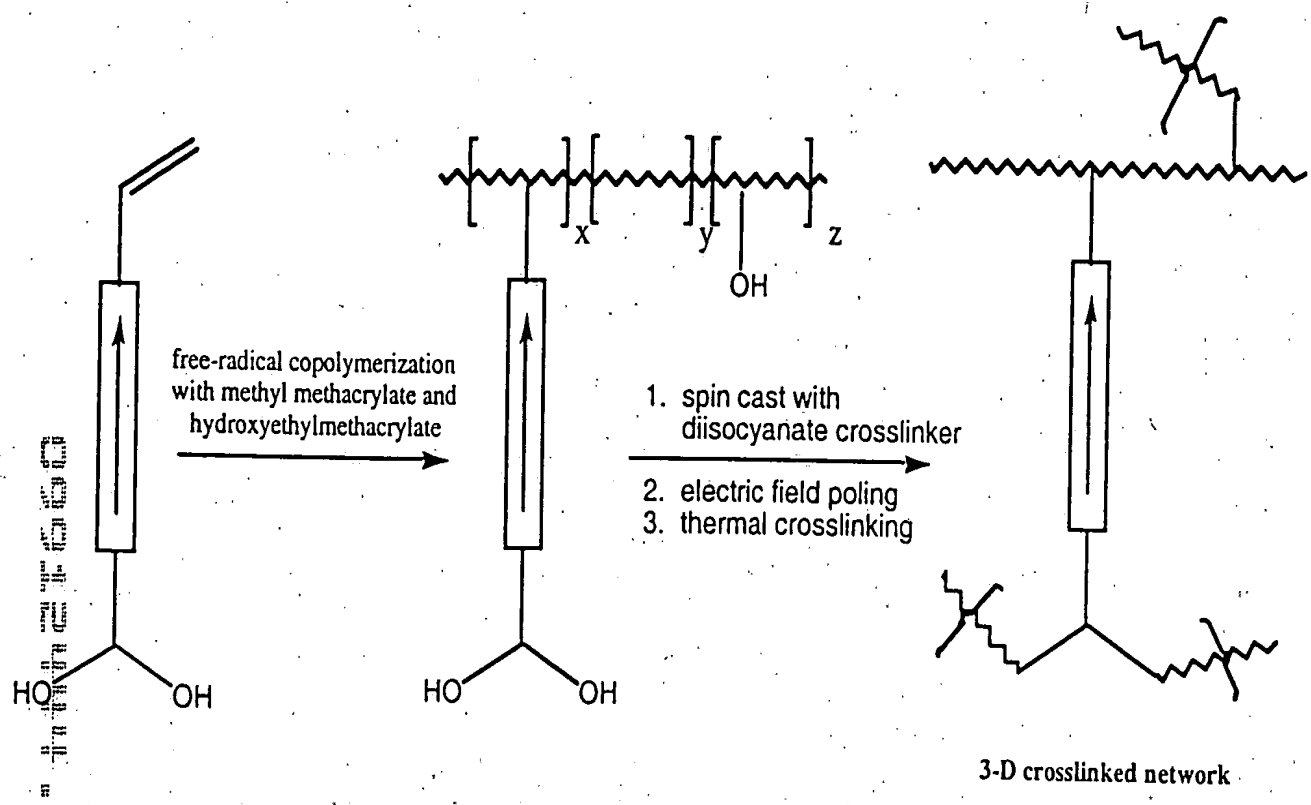
$$\rho = 2\pi r_{33} n^3 L V_o / T\lambda$$

Comparison of key features of simple devices

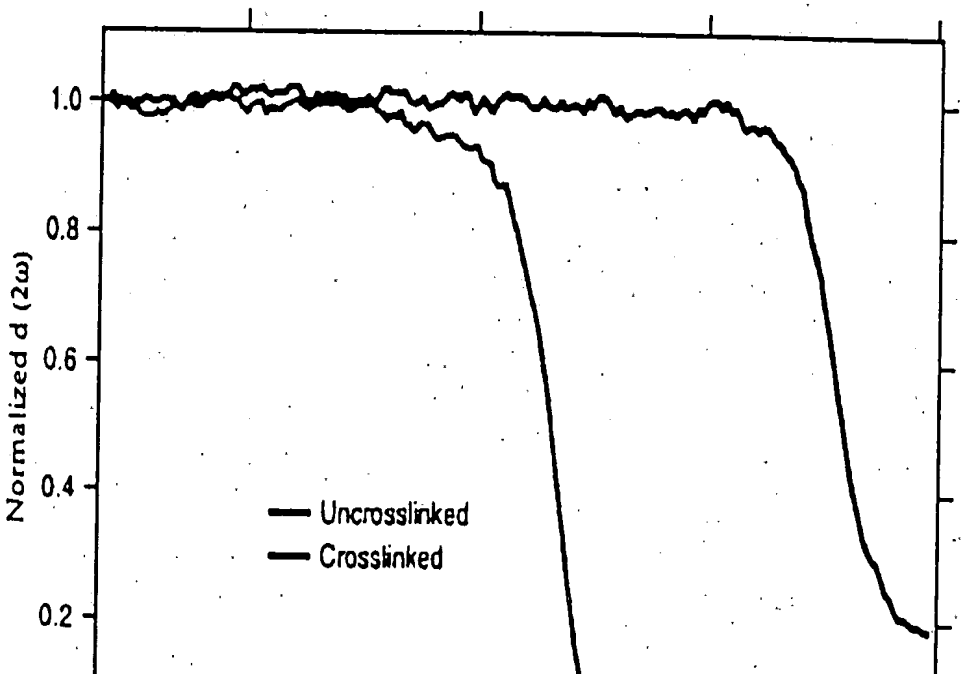
	Mach Zehnder Interferometer	Birefringent Modulator	Directional Coupler
r_{eff}	r_{33}	r_{33}-r_{13}	r_{33}
V_π	$V_{\pi MZ}$	1.5 $V_{\pi MZ}$	1.73 $V_{\pi MZ}$
Mod. Power	P_{MZ}	2.75 P_{MZ}	3 P_{MZ}

FIGURE 42

Title: [redacted]ERPOLARIZABLE ORGANIC CHROMOP[redacted]ES
Invent[redacted] L.R. Dalton et al.
Docket No.: UOFW117403



3-D crosslinked network



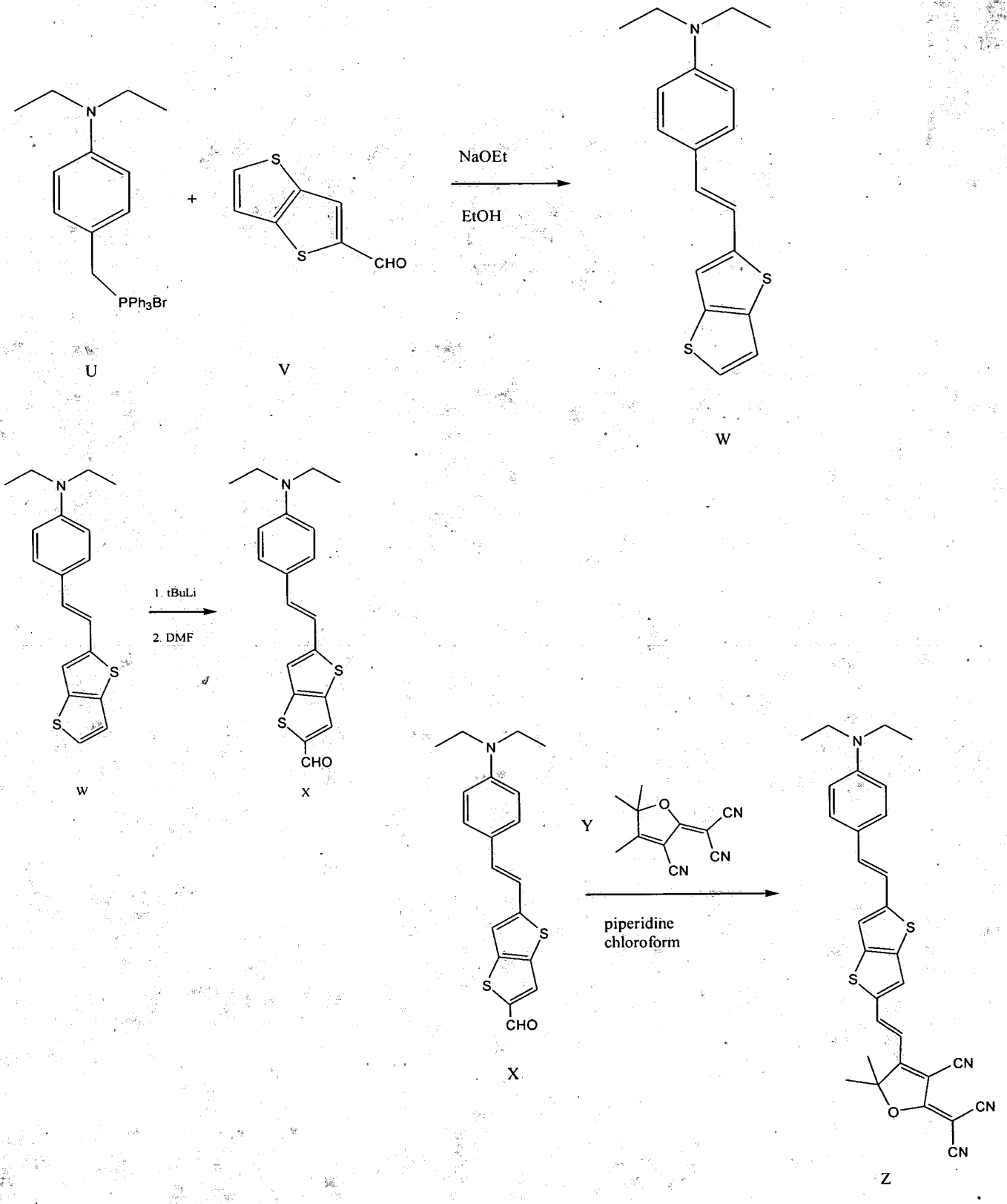
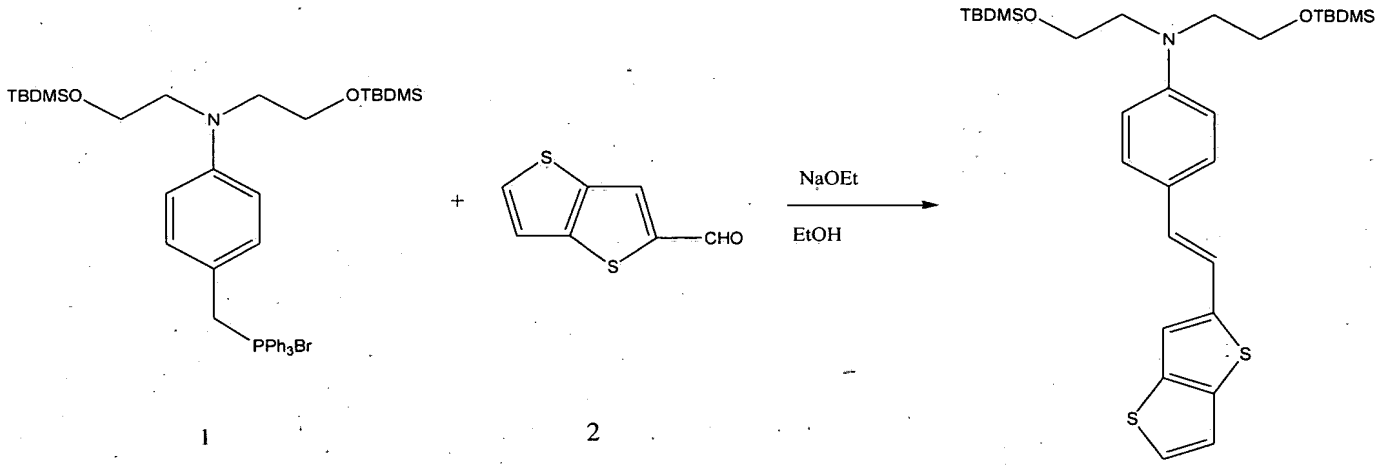
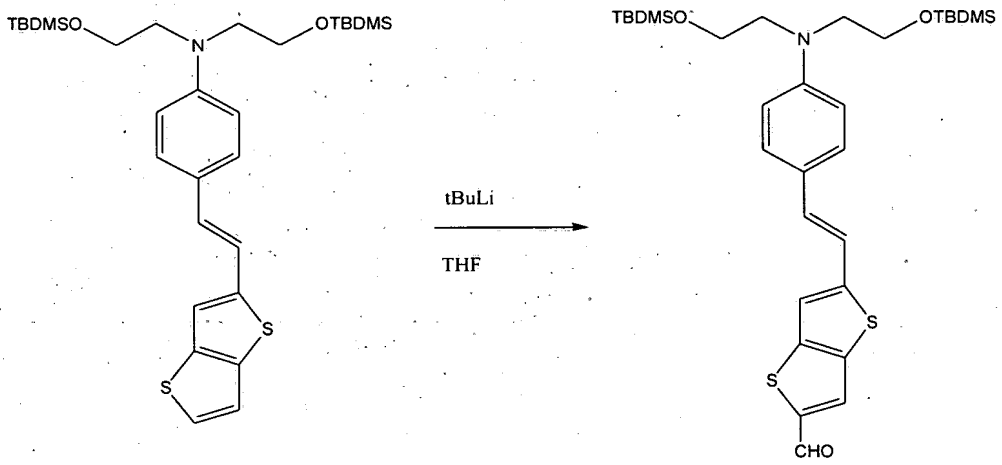

N
PPh3Br
S
CHO
NaOEt
EtOH
U
V
W
1. tBuLi
2. DMF
X
Y
CN
O
piperidine
chloroform
Z

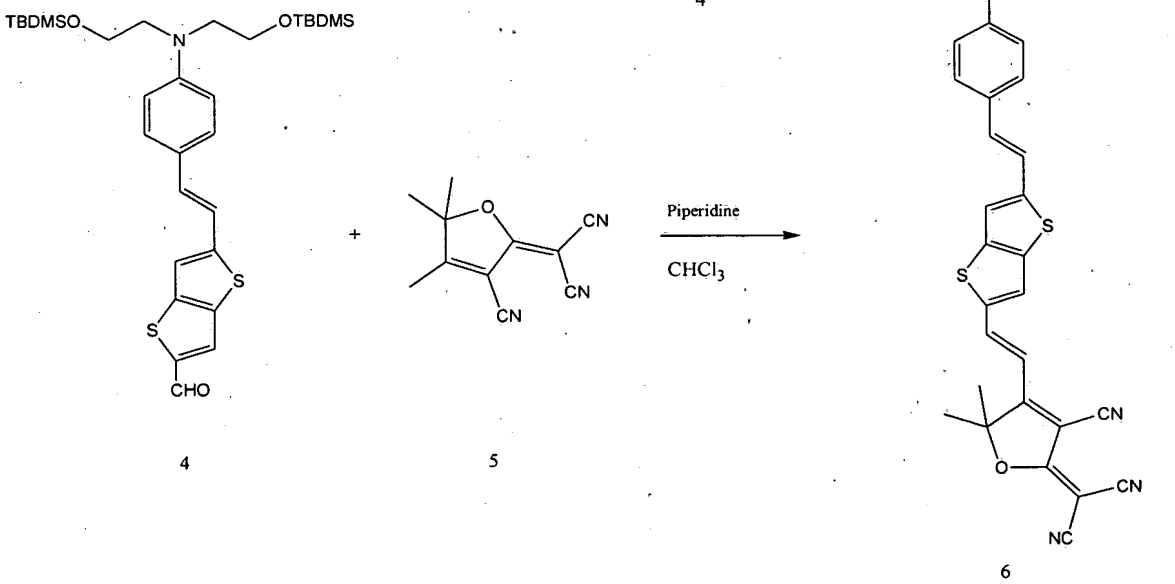
FIGURE 45



1 2 3



3 4



4 5 6

FIGURE 46

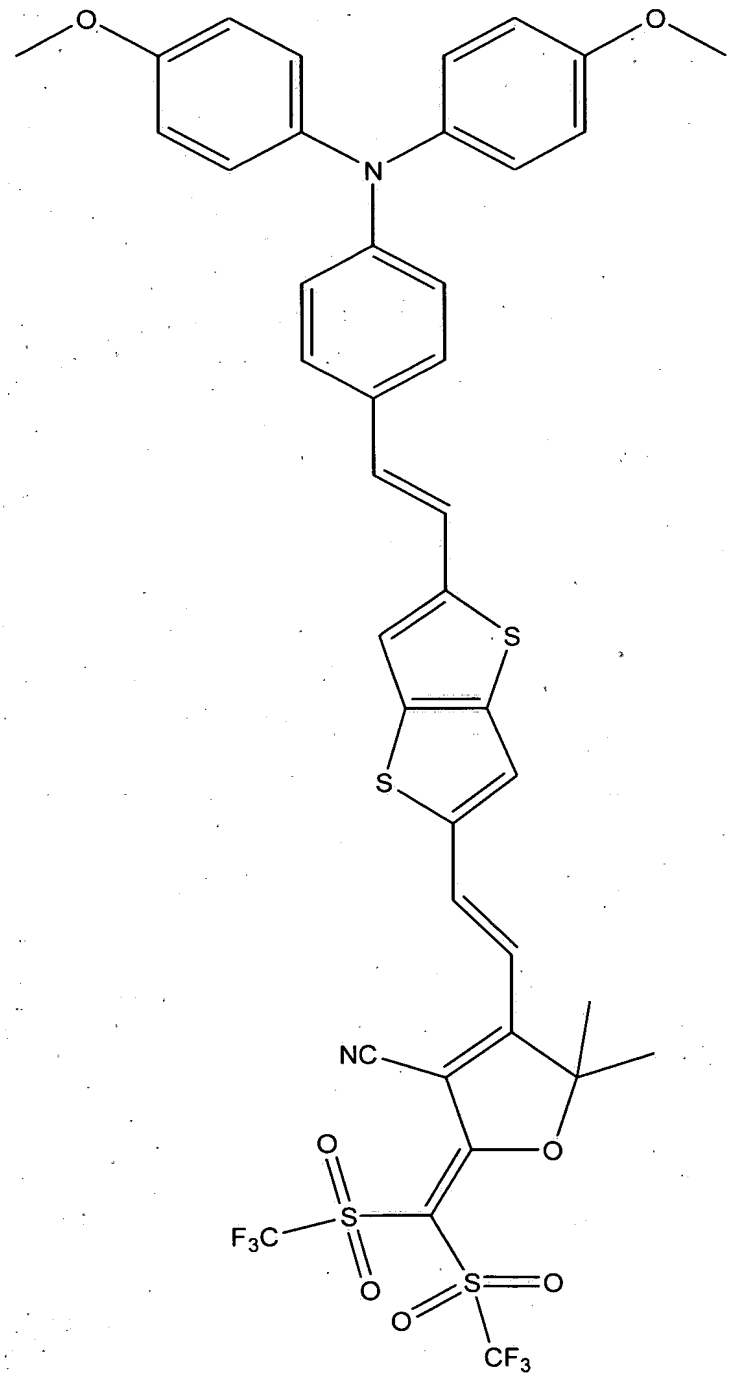
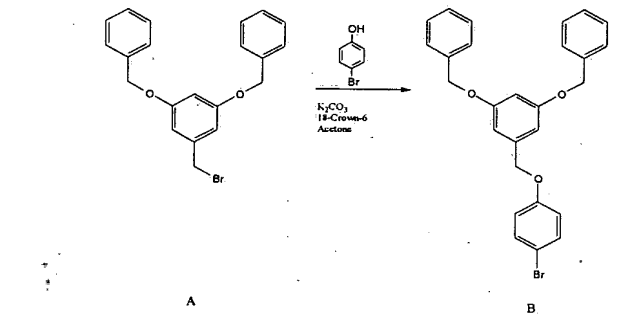
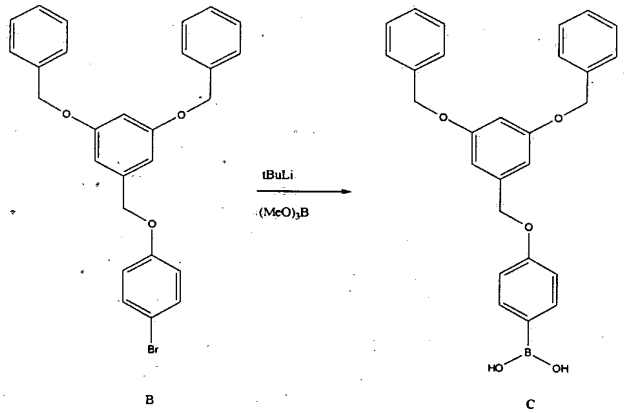


FIGURE 47

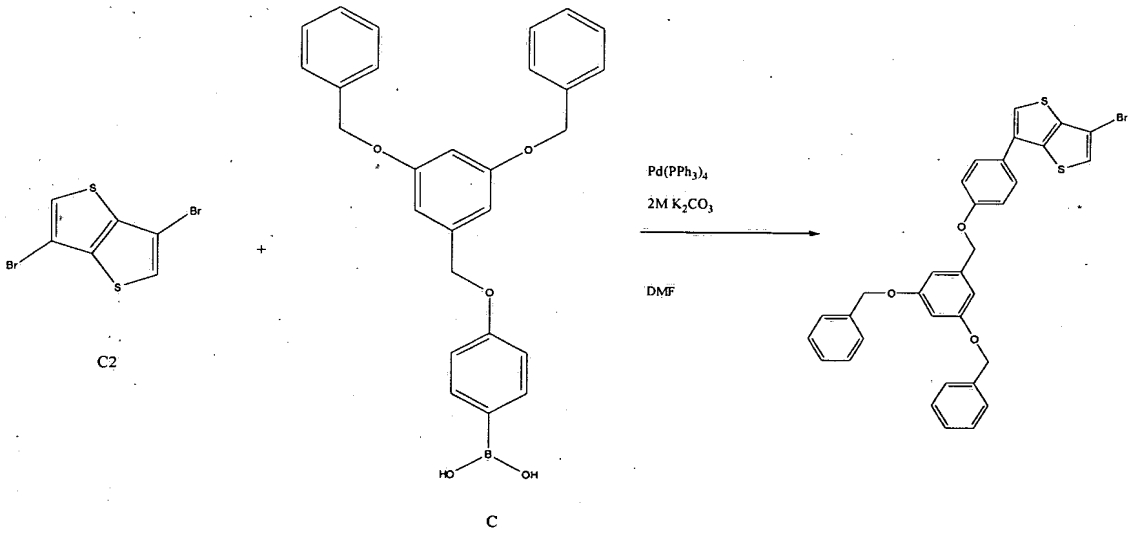
T[redacted] HYPERPOLARIZABLE ORGANIC CHROMOPHORES
I[redacted]ors: L.R. Dalton et al.
Docket No.: UOFW117403



A B



B C



C2 + C D

FIGURE 48